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Electrical Construction and Maintenance

CONTRACTING

DECEMBER · 1947

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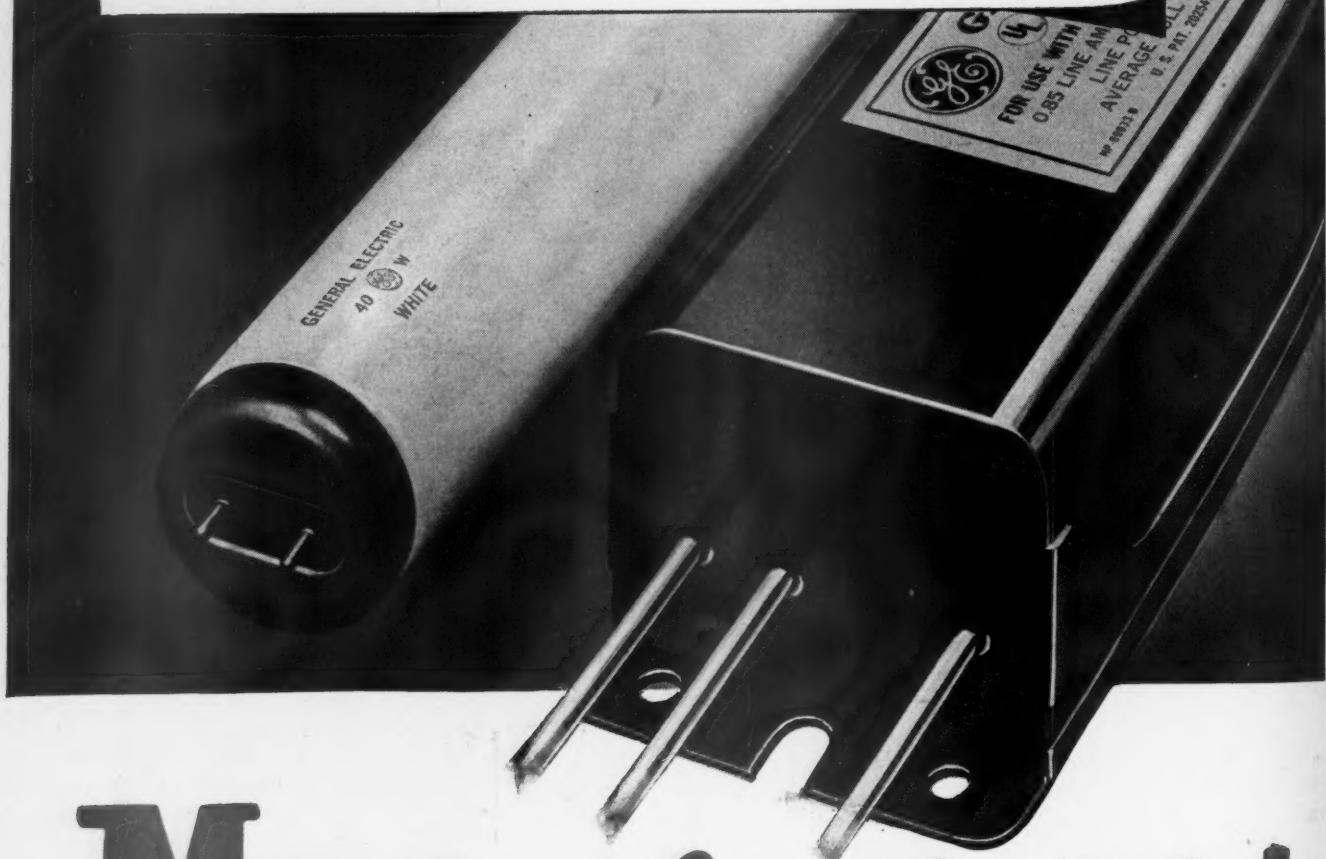
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Electrical Construction and Maintenance

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A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering installations, repairing, maintenance and management, in the field of electrical construction and maintenance.

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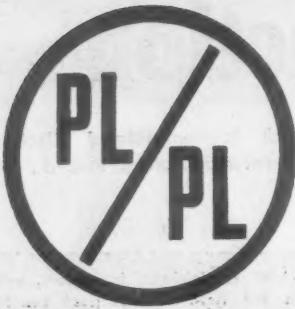
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DECEMBER . . . at a Glance

Lighting Awards

The three Gold Seal Award winners in the International Lighting Exposition lighting competition under the electrical contractors classification are reviewed in this issue on page 52. Chosen by the judges from among the many excellent examples of modern lighting application presented in the contest, the jobs winning Gold Seal awards are important achievements in the field of applied lighting. This year's contest was the first to be conducted on a national scale. It brought together a wealth of information and sound practical examples from the best of current illumination practice. It brings the support of experience data to the sales efforts of lighting men everywhere. The contest deserves to be a regular feature of the Lighting Exposition.

Tools for Production

A dwindling effective labor supply in the presence of a rapidly rising market for the services of electrical contractors calls for a searching appraisal of job methods and job tools. Good tools and the substitution of untiring kilowatts for the hard physical labor of electrical construction can quickly expand the effectiveness of our available working force and make electrical construction work easier and more attractive to ambitious young men. The opening feature article, page 43, in this issue is a roundup and review of effective job tools, both hand and power driven, for better production. An accompanying check list is a comprehensive and convenient guide for appraising your own job tooling practices.

By Others

A group of apparatus, or the lighting fixtures in a particular area or some other electrical material or

equipment separated from the electrical contract to be provided by "others" at the site is a curious practice that persists in some parts of the country. It grew in wartime on fixed fee contracts where procurement under priority procedure was vital and the owners could frequently wield higher ratings more expeditiously than the contractor. In contract work under normal procurement it is both uneconomical and unsound project management to hold the contractor responsible for schedules and installation costs on materials or equipment over which he has no control in choice of manufacture, selection of accessories or delivery. The assumption that by-passing the contractor means a lower price is not borne out in experience. The price the customer pays is not necessarily less than the contractor would have charged. And the high risk and extra expense involved and borne by the contractor is ultimately passed on.

Lighting Maintenance

It is surprising how many otherwise well designed lighting fixtures require practically a disassembly job for routine cleaning and relamping. The spectacle of a maintenance man with four hands atop a ladder juggling lamps and large pieces of fixture may have some humorous aspects for the cartoonist but it is both dangerous and expensive. Poor maintenance design also contributes to poor cleaning and lamping schedules. Some of the newer commercial fixtures are appearing with sections hinged or suspended for lamping and cleaning. Some are completely removable as a unit. These changes are all to the good. Large scale lighting installations at best involve a new order of care and routine attention. In both fixture selection and location, ease of maintenance is a most important aspect of the lighting plan and such ease can only be incorporated at the very beginning of the planning stage.

Switch Control

A notable feature of a big hotel job now under construction is a bedside panel which includes lighting control. All room lights may be switched from one handy spot after the weary traveler retires. It emphasizes what has become almost a blind spot in wiring system design, adequate and handy switching. While conventional 3 and 4 way circuits give unlimited opportunity for several points of control, they are rarely found today except in halls and stairways. Perhaps the new relay switching technique appearing on the West Coast will stimulate interest in providing more switching convenience. It is a market opportunity that is only waiting for a little well planned selling.

Electronic Apparatus

Much of the squeamishness of electricians in the presence of industrial electronic apparatus is plain stage fright. The stuff has been overglamorized. Because circuits are unfamiliar, they are monstrously complex. As a matter of plain fact the ordinary electronic welding timer and control is no more elaborate circuit-wise than a conventional printing press controller. Tubes and components perform switching operations quite as logically as mechanical contactors. Unfortunately, the impression that electronic apparatus is always complicated, however erroneous, is often a compelling reason for avoiding applications that logically ought to be made. The same men, however, who treat such apparatus so gingerly take industrial fluorescent lighting fixtures in their stride. Yet each fixture usually contains two "electronic tubes" with filaments and anodes, resistance, capacitors, transformers and inductive impedances. This most widely used electronic apparatus has been marketed very successfully without the least emphasis on its "electronic" character.

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*WIRE AHEAD, a new booklet discussing preventive maintenance ... the symptoms of inadequate wiring ... and presenting plans for anticipating electrical demand, is now available on request. Address Advertising Department, 25 Broadway, New York 4, N.Y.



ANACONDA WIRE AND CABLE COMPANY

DECEMBER, 1947

A GOOD YEAR

ADDING UP the past 12 months, the critical observer of things electrical must concede that '47 was a good year. Electrical construction volume was well up from the year before. Business was strong, materials were easier, labor was a little less critical and, in some areas anyway, more productive.

COSTS, TOWARD the year's end, look like they are flattening out. Aggressive action against the escalator clause in materials quotations has had good response from manufacturers. It is possible to figure a job again with some hope of coming within gunshot of estimated costs and schedules.

THERE ARE INDICATIONS that major industrial construction reached a peak in '47. Some large companies claim their expenditures for plant expansion may be less next year. However, there is little to indicate any similar trend in electric work. In plant changes, installation and relocation of machinery, major alterations in distribution systems and similar projects are still going strong.

COMMERCIAL WORK just started in '47. A few big department stores were completed, some smaller stores, and outstanding commercial lighting jobs appeared in almost every city. There was enough to indicate startling trends in electrical work but not enough to even dent the potential market.

POWER CONSUMPTION is now through the roof. For many weeks new records have been set. This year our ability to sell and use electricity went beyond our ability to produce and distribute kilowatts. While power shortage is a temporary damper on aggressive promotion of new uses and applications of electricity, it is clear testimony to the dynamic character of the market for electrical goods and services.

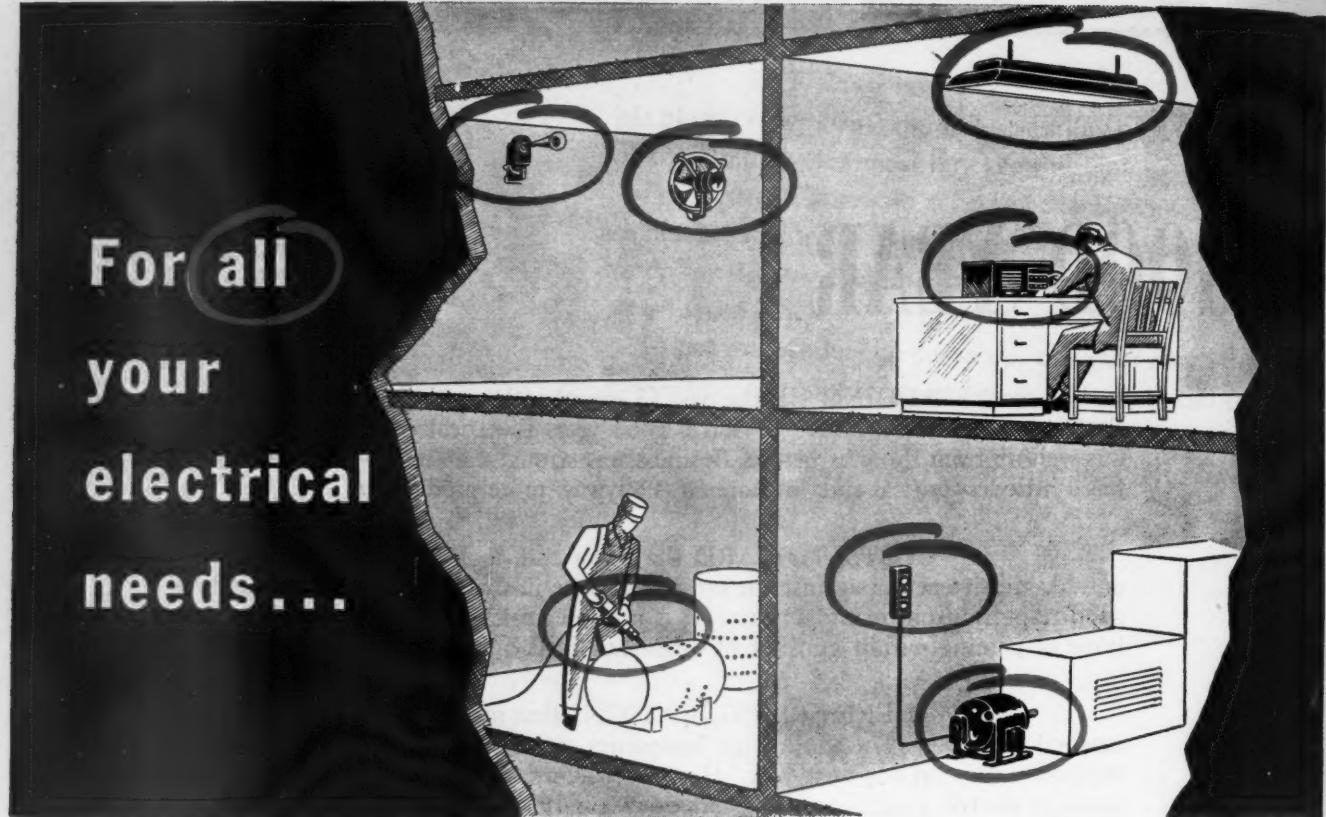
A GOOD YEAR, indeed, but it was hardly a year of inspired achievement. Unsettled trade relations still abound. There is still too much time and energy consumed in materials procurement and labor relations, too little in creative selling and market development.

ACRES OF BUILDINGS strangle unnoticed from gross electrical obsolescence. Industrial plants still worry along with outmoded apparatus, unaware of modern developments in motors and control. Whole commercial communities never felt the compelling merchandising power of modern planned lighting. At the same time modest new structures fresh off the drawing boards enjoy vigorous competition.

THE ELECTRICAL CONSTRUCTION industry is ripe for a new awakening of plain commercial enterprise. It has never been so well set to accept the challenge of an expanding market. Few industries ever faced greater opportunity.

Wm. J. Stuart

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TOOLS for PRODUCTION

Good tools and effective job handling equipment are the keys to higher productivity and to control of labor hour costs. This editorial round-up of tools for more production provides a useful guide for your own job tooling program.



MODERN job tooling has become one of the most urgent problems in electrical construction operations. The industry is faced with a rapidly growing market which will evidently continue at a high level for seven to ten years. While minor shakeouts may occur, the field outlook is optimistic. To handle this increasing volume of work, there is a stable and, in some areas, dwindling effective labor supply. Apprenticeship is not keeping pace with requirements and while some improvement will come in time, it is unlikely that the full effect of present apprentice programs will be felt for several years.

While changes in materials may bring reduced labor-hour requirements on some types of electrical installations the great opportunities for increasing productivity is in the field of job management and job methods, particularly in the effective use of modern tools and power on the job.

Good tools complement and aid the skills of good men. Some provide skillful results in less able hands. Tools of mechanical advantage and power tools cut down fatigue and do work well beyond the mechanic's physical powers. Thus, they greatly extend the effective working life of our top-flight experienced mechanics. Further, by easing the physical labor of electrical work, the field becomes more attractive and challenging to ambitious young men.

So from the standpoint of meeting manpower requirements in the years ahead, modern job tooling helps in

two ways; by increasing the effective labor force and by increasing the productivity per man.

Supervisory costs are a direct function of productive man hours. Modern methods and job tooling not only expand the volume of work which can be handled by working crews but increase the effectiveness of scarce and hard to train experienced supervisory personnel. Further, labor hour unit data based on power tooling is less subject to erratic variations in individual productivity. It provides the basis for better and more accurate estimating.

Tools should be charged against jobs at a realistic rate of depreciation and interest that will permit them to be kept in first class repair and replaced when necessary. Good tools can pay their own way and should be handled so that they will. The simplest method is to carry tools under an inventory account credited by a flat per day charge against the job. On big jobs it is often better to charge the full value of the tool and

on return credit the job with an appropriate depreciated value. A systematic accounting and "tool room" procedure is a prime essential to effective job tooling. The attitude in many shops that tools and tool repairs are "expensive" is too often a case of inadequate accounting.

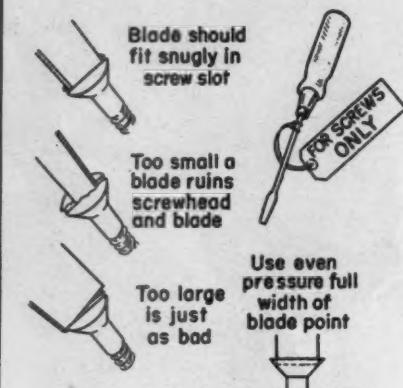
A recent survey of tool users among our readers indicates that selection of tools is predominately on merit. Price is relatively a secondary consideration. Brand preferences are strong, apparently based on past experience. But new tools which show promise of real performance get ready acceptance. Tool inventories are considerably larger than ever before.

In the following pages we have brought together a review of hand and power tools with special emphasis on those which are finding much wider use today. The accompanying check list of electrical construction tools will provide a useful guide to your own tool requirements.

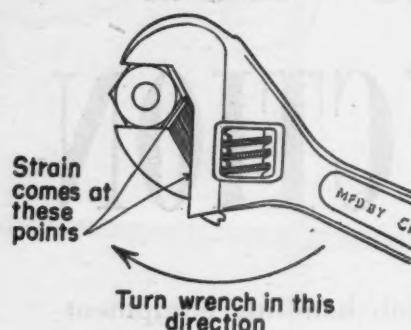
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The editors wish to express their appreciation for the cooperation of the following tool manufacturers who helped to provide much of the background data and illustrations for this article: Beaver Pipe Tools, Inc., Black & Decker Mfg. Co., Blackhawk Mfg. Co., W. H. Brady Co., Carboloy Co., Inc., Crescent Tool Co., Henry Disston & Sons, Inc., Greene, Tweed & Co., Greenlee Tool Co., Hullhorst Micro Tool Co., Ideal Industries, Inc., Ingersoll-Rand, Kett Tool Co., Mathias Klein & Sons, Misener Mfg. Co., Shepard-Niles Crane & Hoist Co., Super Tool Co., Syntron Company, Tal Bender, Inc., Tempo Products Co., Western Lithograph Co., Wodack Electric Tool Corp. and Yale & Towne Mfg. Co.

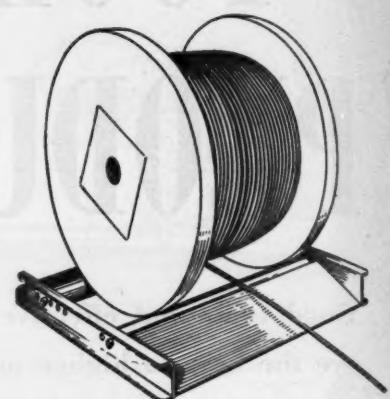
Hand and Mechanical Tools



Using the wrong tool damages both tool and work. Abusing an implement ruins its efficiency. Screw drivers should never be used as punches, prybars or chisels. Screw drivers should be used only for driving screws.



Tools, used in accordance with design and manufacturers recommendations, will give long and reliable service. Wrenches are designed to give maximum strength when turned in the direction indicated by the arrow.



The problem of handling heavy reels is solved by using a reel roller. Light in weight, it can be easily moved to any desired location.

TOOL SELECTION

Surveys show that tool selection depends upon many factors, both physical and personal. In this connection, three basic questions must be answered. First; what does the tool do? Second; how does it work? And third; what is its construction?

Knowing the function of an implement is essential before it becomes possible to determine whether it fills a practical purpose, whether there is a need for it, and whether it is the best implement for the job. There is also the associated factor of savings; in time, materials, labor and money. No less important than the capabilities of a tool are its limitations and its adaptability for performing more than a single specific operation. Seeing the tool in operation answers many of these questions. That being impractical, a picture of the tool in use and detailed drawings are of definite assistance for intelligent specification.

In considering the operation of a tool, the questions of skill and safety arise. Concerning skill, it is important to know whether special training, knowledge or techniques are required. Referring to safety, such factors as insulation against tool-borne shock, and protection around cutting edges, moving parts, gears and saw teeth should be ascertained.

Perhaps the most inclusive question is that of construction. Size and weight of a tool determines portability.

They also measure the ease with which it can be used without resulting in operator fatigue. If there are many component parts in the unit, the buyer should know which parts are apt to wear out or break during normal use, what the availability of replacement parts is, whether the parts are interchangeable and where to get the parts when it becomes necessary. Besides carrying the name of a reliable manufacturer, approvals by NEMA and Underwriters' standards are an indication of proven value. Knowing the tests to which the tool has been subjected gives an indication of durability and expected life.

Finally, value should be equated and balanced with price. Although performance is rated above cost, buying expensive tools for limited, infrequent use deserves serious consideration and economic evaluation. If the cost is justified, it is necessary to find what wholesaler, supply house or hardware store carries the desired unit.

TOOL CLASSIFICATION

Tools for production in electrical construction can be divided into two broad classifications; hand and power. Hand tools are not necessarily those held in the hand. Rather, they are tools which are manually powered. Most hand tools transmit force, rotational or lineal. They depend primarily upon the force created by the operator. A tool is considered mechanical

only when this force is materially multiplied by applying the mechanical principles of the lever, wheel and axle, pulley, inclined plane, wedge, screw, toggle joint or hydraulic press. The tool becomes known as a power unit when the driving force, combined with one or more mechanical principles, is motor produced. Thus, light weight, motor driven units with mechanical advantage rightly fall into more than a single classification. However, the division line is flexible and is drawn for reference rather than for technical accuracy.

Since tools legally include all items facilitating work, many objects without motion or moving parts must be mentioned. Anvils and work benches fall into this category. They are classed with hand tools because they are usually associated with manual operations. Reference to the Tool Check List indicates other examples.

Reference to a Check List is a positive aid when planning a job. It acts as a mental refresher, perhaps suggesting items previously overlooked. It insures the inclusion of tools necessary for efficient operation. Many of the items listed are included in the Mechanic's Tool Kit. Others are Tools for the Job. All are important if, by their inclusion, economy, efficiency and safety are the resultants.

MECHANIC'S TOOL KIT

While many special tools and tech-

TOOLS for PRODUCTION

niques are required today for the installation of specific products, the basic tools of the trade are those in the mechanic's kit. Implements and items so classed are included in the Tool Check List prefaced by the letter "K". These items are recommended to ex-service men entering the electrical field as apprentices under various Veterans Training Programs. These items are also included on the lists of numerous electrical associations and individual contractor groups. With such a selection, the electrician becomes self-sufficient for completing the majority of residential and normal bread-and-butter commercial jobs. Individual kits vary with needs and personal choice but the items listed are universally recognized as fundamentally essential.

Financial provisions of the "G. I. Bill of Rights" furnish strong incentives to veterans to own their own tools. Other programs exist where similar inducements are extended to civilians without military or naval records of service. But with or without financial assistance, it is advantageous for every journeyman to own these tools.

Accuracy is second only to workmanship. For this reason, many tools in the mechanic's kit are included to insure precision. The folding zig-zag rule, the machinist's scale and steel tape measure exact lengths. The combination square, carpenter's level and surveyor's plumb bob guarantee horizontal, vertical and right-angle runs. Chalk lines insure straight runs. Gages are necessary to verify wire sizes and carrying capacities. The center punch marks exact locations and is important for accurate drilling.

Other tools are preparation aids. They prepare areas prior to actual installation. Such items are the carpenter's tools, chisels, ratchet braces, bits and drills. Items for safety are the flashlight and fuse puller. Multi-purpose implements include a heavy duty pocket knife and a pair of 10-inch scissors. For on-the-spot verification of permissible procedures, the National Electrical Code book should be included.

The tools for direct use in installation and maintenance work are basic. An assortment of screw drivers, small and medium wrenches, pliers, punches, reamers and taps are so listed. A hacksaw and a variety of blades is a necessity. Many uses are also found for a



Mechanical equipment includes mobile scaffolds and industrial trucks. This Yale and Towne truck is used for high bay maintenance and installation work. The chain drive raises the working platform smoothly and rapidly.

1-quart alcohol or gasoline blow torch. Fish tape clears conduits prior to wire pulling.

CARE AND REPAIR OF TOOLS IN THE KIT

Tools kept in a constant state of good condition are signs of the true mechanic and efficient contractor. It indicates pride in a job well done. It is sound sense, for good tools are both costly and difficult to replace. Excellent general maintenance rules are to keep tools clean, remove rust, use genuine replacement parts, properly lubricate moving parts and keep cutting edges sharpened. Maintenance need not be excessive to be effective. In fact, lubrication carried to the point of excessiveness creates a dangerous slipping hazard. Oil should be used often but sparingly.

Other recommendations apply to specific groups of tools.

With adjustable wrenches, as with most tools, abuse and neglect are the commonest causes of failure. Wrenches should be kept clean and oiled. Rust and dirt on the knurl results in diffi-

cult adjustment. Wrenches should not be used as hammers. They are not designed for unlimited overload or strain. Many wrenches in the 18-inch class and over can be safely stressed by extending the handle length with a section of pipe. But smaller wrenches are designed only for direct manual pressure. A point to be remembered is to keep jaws tight. This will prevent slipping and rounding the corners of hexagon nuts. It minimizes strain on the wrench. It also saves skinned knuckles. Greatest strength is developed when pressure is applied to the side carrying the fixed jaw.

The screw driver is the most mis-treated tool in the kit. It is not to be used as a chisel, prybar, punch or hammer. It should be used only for the purpose for which it was designed. A cabinet screw driver will be ruined if used for driving a No. 10 screw. Using one corner of a large screwdriver to sink a small screw will damage the screw groove. Damaged blade tips should be reground to original dimensions, being careful to prevent overheating. Overheating will draw the temper from the steel.



Benders, equipped with a variety of forms, bend pipe and conduit smoothly, quickly and efficiently to any desired radius. Close offsets, such as this one being made with a Greenlee hydraulic bender for a Saint Louis air conditioning and remodeling job, are made to exact measurements.

Pliers also have special "do's and "don't's. They shouldn't be rocked or used with a prying motion. If they won't cut, resharpen the cutting edges or use a larger size. A pair of side-cutters should not be used on bolt stock. Pliers should never be squeezed in a vise or hammered upon to increase leverage.

Hacksaw blades should always be used with the teeth facing away from the operator. Blades should be true and square in the frames. Since blades are flexible, they should be well stressed to keep cutting edges straight and rigid. It is good practice to retighten new blades after the first few strokes. Breakage necessitates blade replacement much more frequently than does wear. Many blades are broken because too much pressure is applied on a small surface, concentrating that pressure at a single point. As many teeth as possible should be kept in contact with the work to prevent this. Cutting should be maintained in a straight line to prevent cramping and binding. Cutting speeds should be kept between 40 and 50 strokes a minute. Selection of the proper blade should be based upon the work to be done. Blades with 18 teeth per inch are best suited for general work and for use on tool steel, iron pipe and light angle irons. Using 14 teeth per inch is best for soft steel and iron. Copper, brass and medium tubing calls for 24 teeth per inch. Thin tubing and sheet steel is best cut with a blade containing 32 teeth per inch.

The use of cold chisels is governed by a few simple but important hints. Since cold chisels are designed to cut metals softer than the tool itself, a large enough chisel for the job at hand should be used. The center of the blade rather than one point or corner should be used. Use a heavy hammer for striking. Too light a hammer will burr the



Rigid conduit and pipes with diameters between $1\frac{1}{4}$ and 2-inches are bent by this Blackhawk hydraulic pipe bender. The 20-ton hydraulic ram can be detached from the bending frame and used with various attachments for general shop maintenance and repair work.

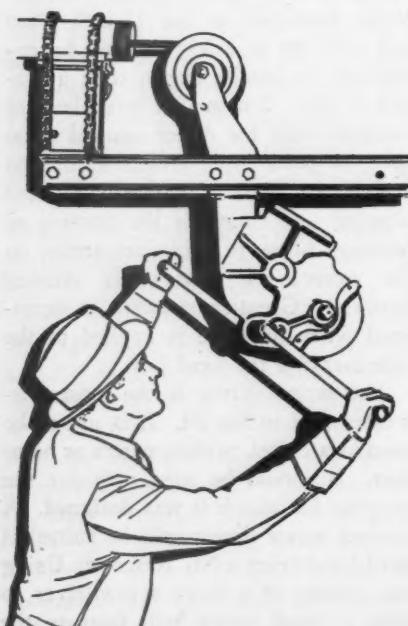
chisel head without transmitting efficient power. In regrinding the head, an angle of 60 degrees should be maintained between the two bevel surfaces. When using the chisel for shearing, the tool should be held so that one bevelled surface is parallel to the shearing plane.

Regarding punches, when driving out rivets or pins, the size should almost fill the hole. Using too small a punch often upsets the end of a soft pin and causes it to bind. In the event that a punch becomes wedged in a hole, tapping it sideways may bend or break the punch or force the hole out of round. The punch should be driven backwards with another punch, or by hammering the pin back into its original position.

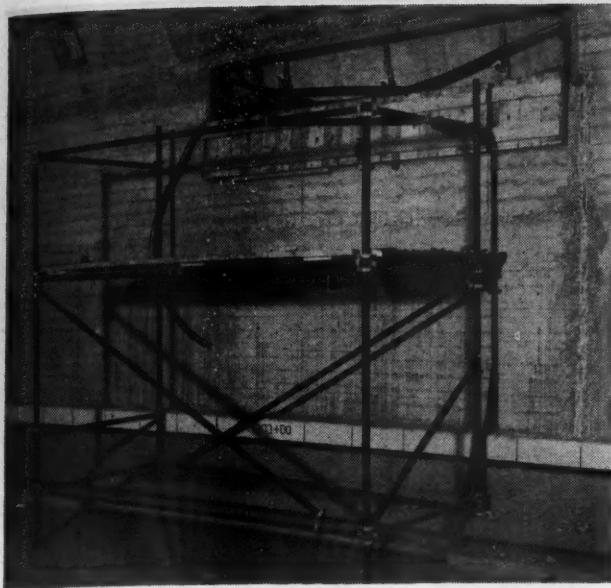
TOOLS FOR THE JOB

A mechanic's tool kit, in effect, increases his effectiveness as an individual. Many tools are necessary for the effectiveness of many, rather than for the effectiveness of one. They increase overall installation efficiency. These tools are essential for a satisfactory job. They include special equipment, general supplies, the larger hand tools, many mechanical implements and power-driven tools.

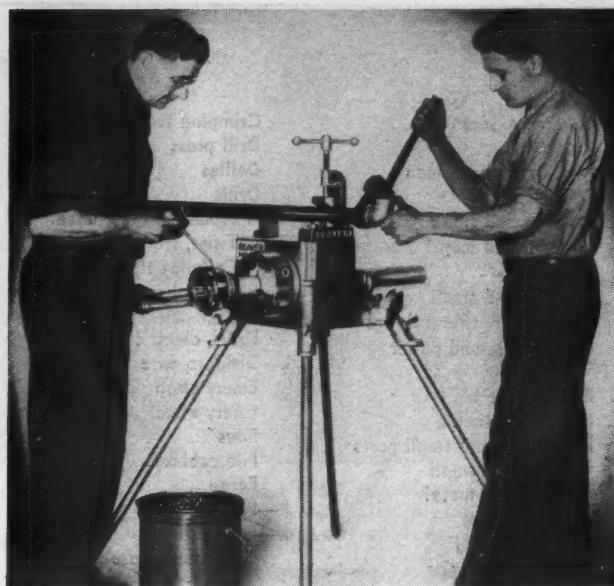
The larger hand tools include woodsman axes, bullpoints, crowbars and pinch bars, sledges, large wrenches, reamers and shears. General supplies include lubricants, safety equipment,



Cable pullers can be attached directly to conduit. Directing sheave pulls cable straight from the pipe. Winch for pulling cable can be manually or power operated.



Scaffolding material is an essential on every large job. By adjusting the lengths of the individual legs, working platforms can be established wherever required. Quickly assembled and taken apart, the material takes little space and can easily be taken from one location to another.



Portable stands, equipped with chuck, shoe and vise for holding pipe during threading, bending and tightening couplings and elbows, are essential on the great majority of conduit installation jobs. Sufficient lubrication, proper use of wrenches and care are indications of efficient mechanics.

marking devices and small replacement parts. Lubricants run from graphites and pulling compounds to oil and oilers. Safety equipment ranges from rubber gloves to welding goggles. Marking equipment includes such items as lettering sets, paint and adhesive marking bands for cables. General supplies also list cleaning waste, conduit seals, solder and solder paste. These items are not essential to the physical distribution system yet they promote safety, accuracy and efficiency during the period of installation. Equipment, materials and supplies must be segregated and safeguarded so Tools for the Job rightly include stock bins and cribs, file cabinets and lockers. Working areas must also be provided, so work benches, pipe stands and rigid scaffolds are listed. For the actual wiring operations, there must be wire strippers and splicing tools. Crimpers and hiccups are also in this classification.

MECHANICAL TOOLS

Mechanical tools, through the application of mechanical principles, multiply the effectiveness of the operator. With their use, the mechanic gains mechanical advantage. Fast completion schedules, so common today, demand that manual power be augmented and conserved wherever possible. Many mechanical tools are in common use. Others are relatively new.

One of the commonest is the bender.

But no longer is it merely designed to bend pipe. Benders must now be multi-purpose to work with new products in the field. To handle this work without correct tools is both uneconomical and inefficient. Variety in tools and uses has increased with variety in methods and products.

Benders large and small are now designed to handle pipe, conduit, thinwall tubing, iron, and copper bus. The original principle of the lever multiplied manual effort in proportion to the length of the lever arm. Adding the principle of the hydraulic press has made the tool a rugged work horse with limitless power and applications. Pipe benders eliminate the necessity of countless fittings and welds. They make absolutely uniform bends in excess of 180 degrees. Bends can be made while materials are cold. Unskilled labor can be advantageously employed with a minimum of training. The equipment can be easily transported.

Offsets can be produced smoothly, quickly and efficiently. A wide variety of bending forms are available.

The principle of the hydraulic ram is also used for high-capacity jacking equipment, presses, wedges, underground conduit pushers and for exerting tremendous pressure in any desired direction. By placing an all-directional ram at the desired location and connecting the ram to a conveniently-placed hydraulic pump by means of a high pressure hose, great power can

be developed in confined quarters and tons of power can be harnessed through accessory fittings for pulling, spreading, clamping, pressing, pushing, bending and lifting.

Other commonly-applied mechanical principles are those of the wheel and axle, the screw and the pulley. In various forms, these principles are utilized for snatch blocks, blocks and tackle, cable measuring machines, chain and coffering hoists, grinders, emery wheels, extension ladders, winches, reel rollers and cable pullers.

The cable puller, like the pipe bender, is another example of evolutionary progress in the field. Winches, blocks and tackle formerly were the only means to supplement manual effort in pulling cable. Now cable pullers can be clamped directly to the mouth of a conduit, an adjustable sheave positioned so that cable is pulled straight out from the conduit, and a geared winch is used for the mechanical advantage. Cable pulling becomes a one-man operation. Attachments make it possible to insert the directional sheave completely inside a junction box, and flexible roller elbows provide the means for leading cable, without damage, around bends or to a more convenient location for the winch.

Still other tools operating on mechanical principles are cable brakes, gang and payout jacks and chain tongs.

Rolling equipment is rightly classed as mechanical, with cranes, mobile scaffolds and industrial trucks so listed.

TOOL CHECK LIST

Ackerman sets	Crimping tools	Insulating sleeves	Scaffolds, rolling, rigid, sectional
Anvil	Drill press	Jacks	k—Scissors, 10-inch
Axe, hand, woodsman	Dollies	Screw, reel, gang, payout	k—Screw drivers
Banches, work	Drills	Manual, hydraulic	Insulated handles
Large and small	Wood, masonry, steel	k—Knife, pocket, heavy duty	Manual, power driven
Wood and metal	Twist, star, tall reach	Ladders	Shears
Benders	Carbonyl tipped	Step, "A", rigid, extension	Manual and power driven
Large and small	Manual and power driven	Lettering sets	Solder
Pipe, iron, thinwall, bus	Drills, powder actuated	k—Levels	Soldering pliers, electric
Hydraulic and power	Drills, electric impact	Carpenters, surveyors	Solder paste, irons, pot, ladle
driven	k—Dividers, wire	Measuring machine, wire	Sledges and hammers
Blocks, snatch	Emery cloth	Oil	k—Squares, combination
Blocks and tackle	Emery wheel	Oilers	Strippers, wire
Boxes, tool and small parts	Files	Power drive, universal	Stock, bolt
Large and small	File cabinets	Pushers, cable	Stocks and dies
Wood and metal	Forge	Mechanical, power driven	k—Scale, machinist
k—Braces, ratchet	k—Flashlight	Pushers, pipe	Seals, conduit
k—Bits, drill, wood	k—Fuse pullers	Hydraulic, power driven	Splicing tools
Bullpoints	Generators, gasoline, portable	Paints and varnish	Threaders, pipe, conduit
Brakes, cable	Grinders	Pinch bar	Manual and power driven
Burners, tanks	Bench and portable	k—Punches	k—Taps
Gas and acetylene	Manual and power driven	Knockout, Whitney	k—Tape, fish, steel
Cable marking labels	Grips	All sizes with dyes	Test lamps
C Clamps	Wire and cable	k—Pliers	k—Tool kit
Chains	Mesh comealongs	Lineman long nose, oblique, glass, gas	Tools, carpenters
k—Chisels, cold	Graphite	k—Plumb bob	k—Torches, 1 qt. capacity
k—Chalk, chalklines, crayons	Goggles, safety	Pulling compound	Alcohol and gasoline
k—Center punch	Gloves, safety, rubber	Pulleys	Torches, soldering, gas
k—Code Book, N.E.C.	k—Gages	Presses, drill	Tester, voltage
Cribs, stock	Wire, screw pitch, drill tap	Plow, cable laying	Trucks, wagon, industrial
Wood and metal	k—Hacksaw, blades and frames	Rope, hemp, wire	Tongs, chain
Crowbars	Straight and circular	Reel jacks, gang and payout	Vises, pipe, machinist
Cutters	Manual and power driven	Reel rollers	Winches, hand and power
Cable, conduit, tubing, bolt, wire, knockout, pliers	Hickeys	k—Reamers, pipe, conduit	Welders, stud
Cable feeders	k—Hammers	k—Rule, folding, 6-foot	Welding equipment
Cranes, chain	Ball peen, claw	k—Saws, wood, rip, crosscut	Waste
Floor and overhead	Plastic and rawhide faces	Conduit, hack, skill, keyhole, knockout	Wrenches, pipe, socket
Manual and power driven	Manual and power driven	Blade, band, carborundum wheel	Adjustable, Stilson, S
Compressors, air	Hoist	Manual, power driven	k—Mechanic's Tool Kit.
Cords, extension	Chain and coffing		

Power Tools

Power tools replace limited muscle power with untiring kilowatts. They bring to bear greater physical force. They eliminate, in great measure, the fatigue element in many routine operations. As a rule, given mechanics of equal skill, the man with power tools will do more work, and better work with much less effort than the man with hand tools. When jobs are planned around the use of power tools still greater economies are possible.

Power equipment for job operation fall in one of three broad classifications:

- 1) Portable powered hand tools—Electric drills, electric hammers, screwdrivers, etc., which

provide power mechanically to tools which are equivalent to conventional hand tools.

- 2) Semi-portable power tools—Pipe machines, power hacksaws, drill presses, etc., machines which may be moved around the job or used at a fixed location.
- 3) Specialized tools—Soldering pliers, welders and similar equipment which uses energy or heat for electrical installation work.

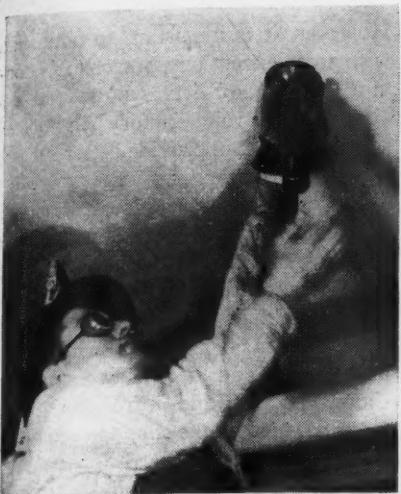
POWER PIPE MACHINES

Pipe machines are used much more extensively on electrical construction

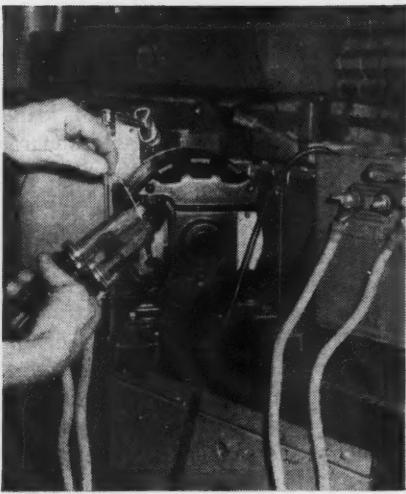
work now than before the war. Most common size used handles up to $2\frac{1}{2}$ inch conduit. Pipe machines are available with attachments for cutting and reaming as well as threading. Interchangeable dies handle all conduit sizes up to the machine capacity. Some types employ a type of die holder which can be thrown open at the end of the cut. Drivers are $\frac{1}{3}$ to $\frac{1}{2}$ hp. single phase motors.

Pipe machines are usually semi-portable. They are most effectively located at work centers as the roughing in progresses. On smaller projects, however, they are often left adjacent to the job storage shed.

There has been long discussion



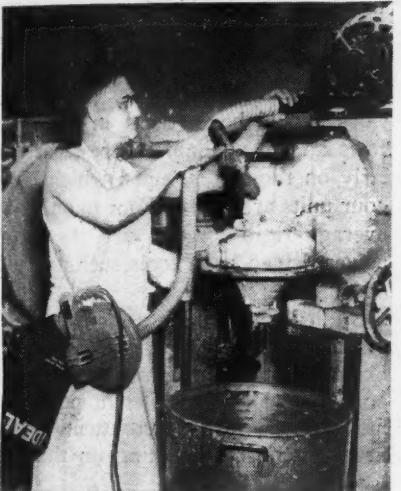
Powder actuated tool sets insert in concrete by explosive charge set off by quick blow in tool base.



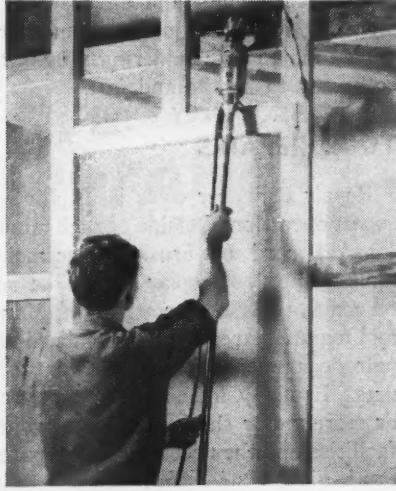
Terminals are soldered by quick heat from current flow through business end of electric heating pliers.



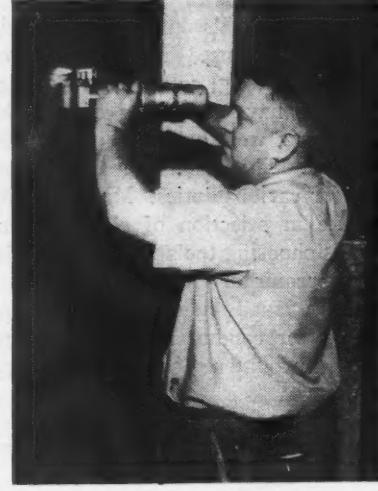
Impact drill combines drill operation with powerful impact mechanism which cannot stall on heavy loads.



Time saving maintenance vacuum cleaner makes short work of dust caked on motor in a bakery.



Electric borer with 10 foot extension bar permits joist and stud boring from convenient floor level.



Cutting control panel housing, plastic or plywood is easy work for this small electrically driven saw.

among job superintendents about the use of pipe machines on the branch circuit sizes. Checks on labor hour units with hand dies and machine threading on $\frac{1}{2}$, $\frac{3}{4}$, and 1 inch conduit give a wide variety of results. Practically, however, the true variations depend on factors other than simple hand vs. machine operation. If machines are deployed generously among conduit installation crews and located close to the work substantial improvements in unit costs can be made. For large feeder conduits sizes of 3 inch and upward a universal drive from the pipe machine can be used to power conventional geared dies.

The power driven hack saw is a less familiar job tool than power threading equipment but an important time saver, particularly in the larger feeder sizes. Once the cut is set up, the machine requires little attention until the cut is completed. It is also useful for making

up job fabricated hangers, angle iron supporting frames and similar jobs. A typical power hack saw takes up to 5 by 5 inch metal. The material is held in a powerful vise with faces machined to make a true 90 degree cut. The saw uses 12 inch blades under gravity feed at 90 strokes a minute.

DRILLS AND HAMMERS

The electric drill is the most versatile power tool commonly used on electric construction work. It consists essentially of a motor, gear train and chuck in appropriate housing. A range of sizes, designs, attachments and accessories makes the unit adaptable to many kinds of work on the job.

Small drills, up to $\frac{3}{8}$ inch, are held by an end handle, usually pistol grip or similar shape. Larger drills are equipped with a spade handle and a switch handle with an additional pipe

handle opposite. Universal type motors for 110 volt a-c or d-c circuits are frequently used; however, it is always wise to check the nameplate data against the available power before issuing such tools to the job.

Most modern portable tools are equipped with a 3 wire cord containing a grounding wire. Where three wire grounding receptacles are not available, this conductor should be grounded to an outlet box screw or other permanent ground.

One recently announced tool has an impact mechanism at the driver end which operates on heavy loads to prevent stalling and to provide powerful torque for such loads as the break through on drilling or tapping. This tool has a square driver which takes a wide assortment of chucks and special tools for drilling, tapping, screw extracting, stud removing, hole sawing, wire brushing and screw driving.

Other types of drills have attachments to convert to hammer operation, angle drilling, bench work and a variety of special uses.

Electric drills on extension arms with angle chucks are used for joint boring. Types especially designed for this type of work are also available. One such tool has an adjustable angle chuck for $\frac{3}{8}$ inch shank bits. The extension permits a 10 foot reach and has a foot stirrup at the base. As with other drills, this tool will take carbide drills for working in masonry.

Electric hammers are of two general types, 1) with a mechanical mechanism to convert the rotary motion of a motor to the sharp hammer blows and 2) the solenoid type in which the hammer is actuated by the free piston action of an electric solenoid.

With star drills and chisels electric hammers are used on all kinds of masonry, drilling, cutting and chasing. Hammers have to be rugged and the mechanism well protected from dust and dirt. They come in a range of sizes for various duties. Most common mistake in selection of electric hammers is choosing tools too small for the service required. However, the smaller sizes are usually adequate for the hole drilling for conduit and box supports usually encountered on electrical work.

ELECTRIC SAWS

Portable electric saws consist of a motor driving a small high speed rotary saw blade in an appropriate housing. They are usually adjustable as to depth of cut. There are specialized types for working on wood and sheet metal. Typical uses on electrical work are cutting pull boxes for butter connections and openings for outlet boxes in plywood or metal panels.

For sheet metal work the portable electric shear is a valuable tool where job cutting of up to 16 gage metal is required. Shears will work to a $\frac{3}{4}$ inch radius and follow straight or irregular lines cleanly.

POWDER ACTUATED TOOL

One tool for inserting studs or driving pins directly into masonry or steel has aroused great interest in the construction industry during the past year. This is the powder actuated hand tool which employs a cartridge charge to drive special inserts at high velocity into the holding medium. Three tool sizes and a variety of charges gives a wide range of penetration in various types of materials. On a typical job

6000 threaded $\frac{1}{4}$ 20 studs were set in hard concrete for pipe straps and outlet boxes using the small size tool.

In use the charge and insert is loaded into the tool, the tool placed squarely against the surface then struck sharply with the palm of the hand. The cartridge fires and the stud is shot into place.

Attachment of electrical apparatus and wiring raceways to steel structural members by welding avoids drilling and expedites installation. A specialized tool that is proving popular on industrial work is the stud welder which firmly welds supporting studs to steel structural members or to heavy sheet.

For soldering and brazing the gas tank with burner accessories is generally replacing the gasoline torch. It is safe, convenient and always ready for use. For work on lugs and terminals the electric soldering pliers are both easy to handle and fast.

TOOL REPAIRS

Repair of power tools is usually an expert operation. Outside of such minor jobs as cord or brush replacement, tools in need of repair should be returned to the shop for attention. Many tool manufacturers have specialized repair departments for their own products. In many industrial centers, one or more motor shops may have proper facilities and the necessary spare parts.

However, it is important to note that, with some exceptions, power tools contain motors and drives of special design. As a rule, factory authorized service shops can provide better service at lower costs.

Power tools get rugged treatment on the job and most are designed to take it. Power hand tools, particularly, which are used against varying loads under all kinds of job conditions are liable to occasional breakdown. Under proper use and decent care, repairs should be few and infrequent. If a tool goes back to the shop too often, the job should be analyzed for possible overloading, and the advice of the manufacturer sought toward solving the problem with a larger size or different type. Power tools should not have to be "babied". At current labor rates power tools are too important in labor hour costs to be less than completely reliable. Some reasonable repairs should be foreseen in estimated costs and in available spares, particularly on those tools upon which labor hour units are based. Four to one is an average ratio for "in use" to "idle" power driven hand tools such as drills and hammers.

Minor repairs such as cord replacements should be made in a workman-like manner with good materials. Temporary repairs are often a persistent nuisance. A little extra attention will keep good tools working on the job.

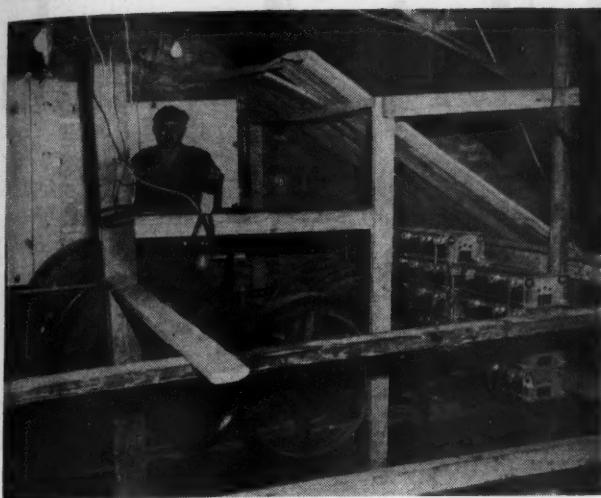
SIZE OF EXTENSION CABLE FOR PORTABLE ELECTRIC TOOLS

Based on current equivalent to 150 percent of full load of tool and a voltage drop of not over 5 volts.

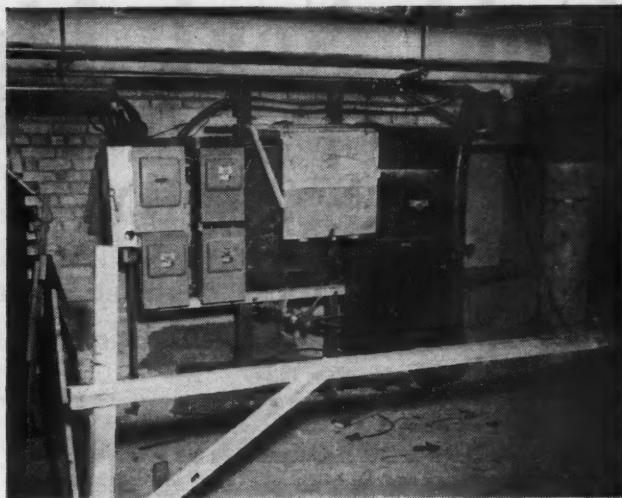
This table is for 110-volt tools. For 220-volt tools use wire size corresponding to an extension length of one-half the contemplated length.

Full load ampere rating of tool	0-2.0	2.1-3.4	3.5-5.0	5.1-7.0	7.1-12.0	12.1-16.0
Distance-Ft. (one way)	Wire Size (B & S Gage)					
25	18	18	18	18	16	14
50	18	18	18	16	14	12
75	18	18	16	14	12	10
100	18	16	14	12	10	8
200	16	14	12	10	8	6
300	14	12	10	8	6	4
400	12	10	8	6	4	4
500	12	10	8	6	4	2
600	10	8	6	4	2	2
800	10	8	6	4	2	1
1000	8	6	4	2	1	0

NOTE: If voltage is already low at source (outlet), have voltage increased to standard, or use a much larger cable than listed in order to prevent any further loss in voltage.



One of six electric winches used by the general contractor on a hotel construction project and served by a temporary wiring system. This is a 100 hp. unit.



A 600-ampere temporary service used to keep a Minnesota hotel in operation during a d-c to a-c changeover. Another 400-amp. unit on back of rack is hidden by main switch.

Temporary Power

Availability of electric power on a construction project is important to a contractor planning to use power tools. Most specifications contain a clause making the electrical contractor responsible for temporary lighting and power circuits for use of all trades working on the project. If service is already available, the contractor need only tap on existing distribution centers and extend his temporary circuits. Should no service exist, he must arrange for a temporary power company connection or provide his own portable generating equipment. During the war, this latter scheme was frequently used to get construction under way before utility lines reached isolated plant locations.

Unfortunately, specifications usually give little indication of size of service needed and leave it entirely up to the electrical contractor. Requirements will vary according to the size and type of project. Best way to determine ampere size is to estimate your own requirements and make allowance for other trades, particularly plasterers on commercial projects where plenty of light is needed. A good guide is this specification of one architect on a large department store project: One mogul base (for 300 watt lamp) and one medium base (for power tools) lampholder for every 1600 sq. ft. of floor area; for smaller areas, two medium

base lampholders. Power requirements may run higher on industrial projects; lighting requirements higher on buildings with numerous offices and rooms.

Regardless of size, application must be made to the local utility for a temporary electric service. Specific installation requirements may vary in different areas, but in general they follow those for permanent installations insofar as materials are concerned. A service head, conduit drop, fused entrance switch and meter cabinet with adequate grounding facilities (frequently a driven ground) are necessary. The "Temporary" label attached to such a service denotes function only. Beyond this service, the contractor can install his open wiring feeders and branch circuits.

General experience has proved that the rubber-sheathed "pigtail" socket takes the most punishment and should be used on temporary wiring for long duration jobs or projects where the wiring may be shifted frequently. On the smaller, short-duration jobs, the pin-type sockets (with sharp prongs that puncture conductor insulation to make contact) may be used. Circuit conductors generally are conventional building wire.

From the standpoint of adequate capacity, a temporary wiring system should be given the same design considerations as a permanent installation.

Insufficient copper and extensive voltage drop can materially impair the efficiency of power tools used on the job and hence reduce the advantages sought. The accompanying chart, which takes into consideration voltage drop, is offered as a guide for determining branch circuit sizes for portable power tool operation.

Temporary power systems can be small or large. On one midwest hotel construction project nine 400-amp. switches (six for 75 to 100 hp. winches), three 200-amp. and one 60-amp. switch (for emergency lighting) were required to serve the temporary power and lighting requirements. Monthly power bills ran between \$1,200 and \$1,300. In this specific case, the general contractor was using the six electric winches to hoist his materials and concrete progressively to the top of the 17-story structure.

Temporary wiring is a definite construction tool. As such it should be included as a job cost when estimating electrical work. Little, if any, of the wiring can be salvaged at the end of the project, hence should be charged the same as twist drills and other expendable material. Of course, electrician's time for installing and maintaining such a system should be estimated and recorded as a separate item and not "borrowed" from the permanent installation labor item.

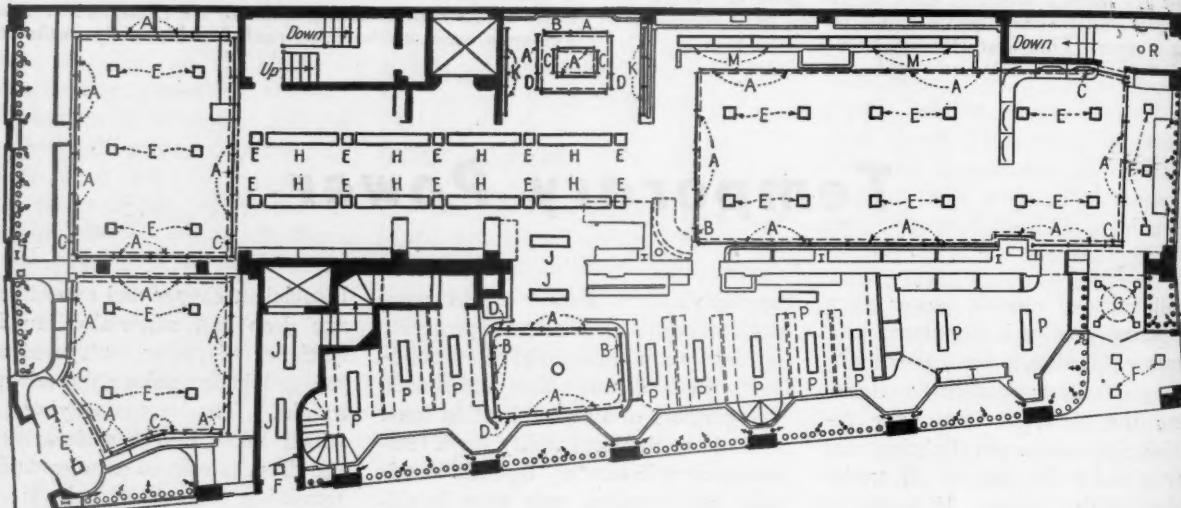
Gold Seal Lighting Awards

WON BY CONTRACTORS

Three electrical contractors receive Gold Seal Merit Awards in
2nd International Lighting Exposition Merit Award Competition.

PLANNED STORE LIGHTING NO. 1

ELECTRICAL CONTRACTOR, G. W. Phelps and Co., Boston, Mass.
INSTALLATION, Lamson and Hubbard, Boston, Mass.

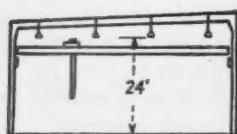


(ABOVE) Lighting layout on first floor shows use of many types of standard lighting units combined to provide appearance of well-planned custom-built installation.

(RIGHT) View on second floor of Lamson and Hubbard's women's apparel store, Boston, Mass., showing combination of fluorescent and incandescent lens lighting.

PLANNED INDUSTRIAL LIGHTING

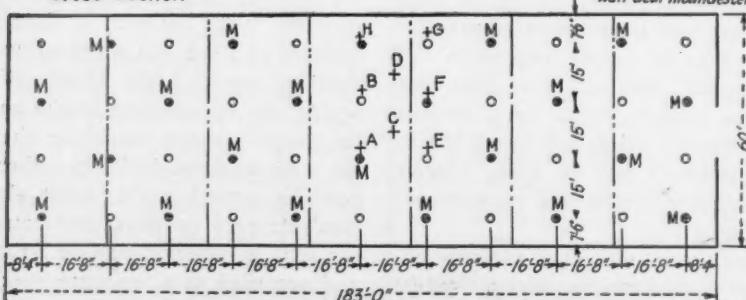
ELECTRICAL CONTRACTOR, Edward J. White Co., Newark, N. J.
INSTALLATION, Air Reduction Sales Company, Murray Hill, N. J.



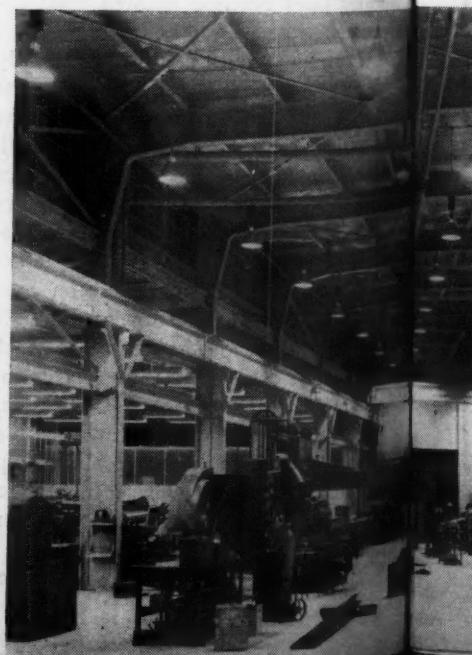
Illumination values
A = 39 footcandles
B = 35 " "
C = 34 " "
D = 37 " "
Average = 36.2 "

Cross-Section

Legend
⊕ Indicates Miller spun aluminum high bay luminaire with a 400 watt mercury lamp
○ Indicates Miller spun aluminum high bay luminaire with a 1000 watt clear incandescent lamp

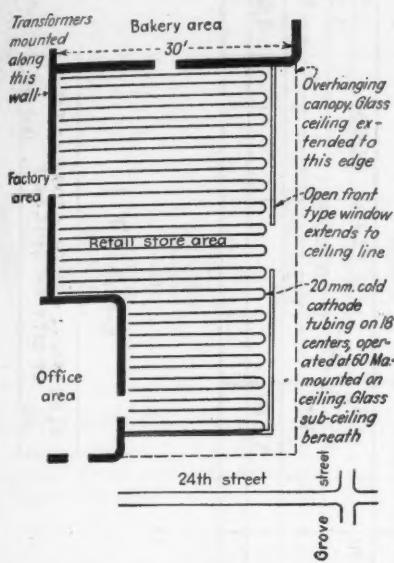


Plan showing layout of lighting units and staggered arrangement of mercury vapor and incandescent reflector units.



PLANNED STORE LIGHTING NO. 2

ELECTRICAL CONTRACTOR, Spott Electrical Co., Oakland, Calif.
INSTALLATION, Duchess, Inc., Oakland, Calif.

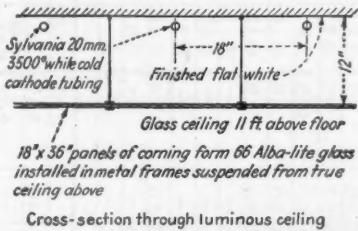


Illumination Levels

The average level after approximately 200 hours of operation is 63 footcandles. Measurements made with a Weston Illumination Meter equipped with a "Viscor" color corrected cell and the average level computed according to I. E. S. Recommended Standard Procedure.

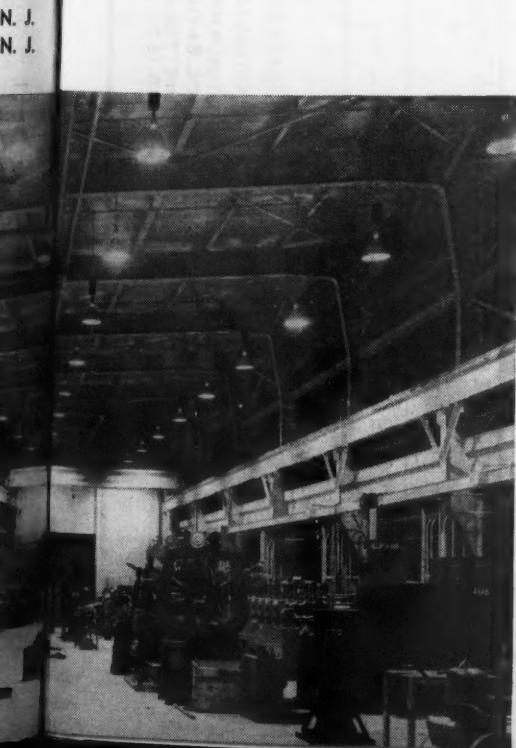
Brightness Measurements

30° above line of sight 15 ft-l. (ave)
90° above line of sight 125 ft-l (ave)
Wall brightness approx. 35 ft-l. (ave)



LEGEND

- A Cove lighting with 1/40 w. fl. lamp
- B Cove lighting with 1/30 w. fl. lamp
- C Cove lighting with 1/20 w. fl. lamp
- D Cove lighting with 1/15 w. fl. lamp
- E Lens plate direct unit with 1/200 w. lamp recessed
- F Lens plate direct unit with 1/150 w. lamp recessed
- G Lens plate direct unit with 1/100 w. lamp recessed
- H 8 ft. unit with 4/40 w. fl. lamps semi-recessed
- J Lens plate troffer with 2/40 w. fl. lamps recessed
- K Lens plate indirect reflector with 1/30 w. lamp mounted in ledge back of wall seat
- L Lens plate indirect reflector with 1/200 w. inc. lamp mounted in ledge back of wall
- M Direct reflector with 2/40 w. fl. lamps mounted back of glass curtain
- P Direct fixture with 2/40 w. fl. lamps
- R Enclosing glass fixture with 1/150 w.
- O Extensive asymmetric show window unit with 1/200 w. lamp
- S Intensive asymmetric show window unit with 1/150 w. lamp
- T Reflector spot 1/300 w. lamp



TECHNICAL DATA

Illumination Data

(Readings taken after approximately 150 hours).
Average Illumination 36.2 Footcandles
(30 Inches Above Floor)
Illumination Under Mercury Unit
(A) 39. Footcandles
Illumination Under Incandescent
Unit (B) 35. Footcandles
Illumination at Center of Four
Units (C) 34. Footcandles
Illumination Under Mercury Unit
In Side Row (H) 39. Footcandles
Illumination Under Incandescent
Unit In Side Row (G) 21. Footcandles
Readings taken with Weston Model 603 Illuminometer No. 3164 on 7-30-47 at 9:34 P.M.

Description of Luminaires

Manufacturer: The Miller Company, Meriden, Conn.
Type & Cat. No.: Spun Aluminum High Bay Luminaires Cat. #PXAN.
Finish of Reflectors: Alzak Aluminum, Reflecting Surface
Diameter of Reflector: 18"
Type of Lamps: 400 Watt High Intensity Mercury Lamps H-1 Wattage including Ballast—450 Watts
and 1000 Watt, P.S.-52 Clear Inc. Lamps
Number of Luminaires:
22 Mercury Units 9.9 KW.
22 Incandescent Units 22.0 KW.
44 Total 31.9 KW.

Combination mercury vapor-incandescent lighting in high bay area provides 36 footcandles of diffused and shadowless illumination of good color quality.

**ESTIMATES OF EXTENDED DURATION COSTS
FOR ELECTRICAL CONSTRUCTION PROJECTS-INDUSTRIAL**
(SEE NOTES BELOW)

ITEMS OF OPER. COST		NORMAL COST		EXT. TIME		NORMAL COST		EXT. TIME		NORMAL COST		EXT. TIME		
THE JOB % OF LAB.	PER COST/MO. \$	THE JOB % OF LAB.	PER COST/MO. \$	THE JOB % OF LAB.	PER COST/MO. \$	THE JOB % OF LAB.	PER COST/MO. \$	THE JOB % OF LAB.	PER COST/MO. \$	THE JOB % OF LAB.	PER COST/MO. \$	THE JOB % OF LAB.	PER COST/MO. \$	
ESTIMATING ENG.&PLANS-INCL FIELD ENG.	1.25 2.75	16.0 352	3.2 70.20	5 14	1.0 2.5	1 6.0	2 2.72	3 3.9	4 —	0.75 1.25	5 7.5	— —	0.70 0.70	2,100. 2,100.
FIELD SHOP & OFFICE	0.5 0.3	6.4 39	13.25 8.50	3 4	0.9 0.2	0.9 4	10.9 5.4	16.25 8.50	4 4	0.2 0.2	300. 300.	20 20	40. 40.	6,000. 6,000.
TEL.	0.2 0.2	2.6 2.6	5.20 1.02	1 1	0.2 0.2	0.2 5.4	8.12 1	1 0.2	0.2 300.	300. 20.10	8 2	0.2 0.2	600. 600.	30. 30.
WIRING & POWER-FIELD TOOLS-CONSUMED&DEPR.	3.5 TIME KEEPER-PRORATA EXP.	450. INCL IN OH.	90.20 —	18 —	3.5 0.7	952. 19.0	136.20 27.50	27 14	3.25 0.7	4,875. 1,050.	325.20 70.50	65. 35.	3.1 0.7	9,300. 2,100.
SUPERVISION COORD.DEL TO EXPEDITE LAB.	2.75 0.3	70.60 39.	42.25 6.50	42 3	2.5 0.2	680. 54.	97.50 8.50	49. 4	2.5 0.18	3,750. 270.	250.50 18.50	125. 125.	2.5 0.18	7,500. 5,400.
TRAVEL EXP-OFFICE TO JOB INSURANCES & BENEFIT FUND	0.25 1.792	32. 360.	6.50 —	3 —	0.2 —	54. 14.	8.50 3.808.	8 544.	4 —	0.15 14.	225. 21,000.	15.40 1,400.	6 —	450. 42,000.
INTEREST ON PAYROLL ASS'N.DUES	0.5 0.7	64. 90.	13.— 14.—	— —	0.5 0.7	1.36. 19.0.	20.— 27.—	— —	0.5 0.7	750. 1,050.	50.— 70.—	— —	0.5 0.7	1,500. 2,100.
PRORATA CHARGES INSPECTION & PERMITS	0.3 0.8	39. 102.	8.50 20.	4 —	0.2 0.8	54. 21.8.	8.25 31.—	2 —	0.2 0.8	300. 1,200.	20.20 80.—	4 —	0.15 0.8	450. 4,400.
RES.FOR CONTING & GUARANTEE	5. 5.	640. 128.	— —	5. 5.	1.360. 1.360.	194.— 194.—	— —	5. 5.	1.400. 7,500.	500.— 500.—	— —	5. 5.	1,200.— 15,000.	— —
DIRECT JOB COSTS-LABOR LABOR OVERHEAD	33.1 22	4,241. 2,816.	845. 563.50	93. 281.	326. 18.	8,865.5. 4,896.	1,268. 700.45	129. 315.	31.33 14.5	46,995. 21,750.	3,133. 1,450.40	299. 580.	93,240. 41,400.	4,663. 2,070.
MATERIAL SERVICE,RES.&OH.	2.75 OF MAT. 4	1,728. DIRECT LABOR INCREASE/MO. INS.&BEN.FUND INCR./MO.	346.20 444. 512.285%	70. 17,025.2434. 72	8% OF MAT. 775. 108.	3,264. 1.33% 108.	467.20 — <td>93. 775.</td> <td>675% 1.33%<td>15,188. 2,000.</td><td>1,012. —<td>202. 200.</td><td>27,000. 1,350.</td><td>270. 20.</td></td></td>	93. 775.	675% 1.33% <td>15,188. 2,000.</td> <td>1,012. —<td>202. 200.</td><td>27,000. 1,350.</td><td>270. 20.</td></td>	15,188. 2,000.	1,012. — <td>202. 200.</td> <td>27,000. 1,350.</td> <td>270. 20.</td>	202. 200.	27,000. 1,350.	270. 20.
TOTAL COST PER MO.			1,028.					1,420.				3,361.		4,974.

NOTE S:-

1- ESTIMATES ARE FOR "60/40" PROJECTS (BASE COST 60% MAT. & 40% LAB.) WITH \$12.00/H.R. LAB. & 5 DAY WEEK.

2- RES. FOR CONTING. INCLUDES ALLOW. FOR INCIDENTALS, ADJ. FACTOR, ETC.

3- ESTIMATES INDICATE THAT DOUBLING THE NORMAL DURATION PERIOD WOULD INVOLVE AN ADDITIONAL EXPENSE OF APPROX. 10% OF THE CONTRACT PRICE. EACH MONTH WOULD BE IN PROPORTION
EXAMPLE - COST PER MO. (EXTENDED TIME) FOR A \$100,000. PROJ.: (NOR. DURATION 7 MO.) WOULD BE APPROX.
(10% OF \$100,000.) + \$1428. (EST. SHOWS \$1420.)

CHART I

IV-\$100,000.(SELL PR.) PROJ. BASE COSTS [MAT. 40,800. LAB. 27,200. EST.DURATION - 7 MONTHS]	IV-\$100,000.(SELL PR.) PROJ. BASE COSTS [MAT. 225,000. LAB. 150,000. EST.DURATION - 20 MONTHS]
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12-46

Volume-Duration Studies—Part IV

By Ray Ashley

Research Engineer
Electrical Contractors Association
of City of Chicago

How to apply Extended Duration Cost Data to preparation of claims for additional compensation where electrical projects run beyond the estimated normal completion time.

TABLES on "Costs of Extended Duration" shown in Chart I were discussed at length in a previous article (Volume-Duration Studies—Part III, pg. 54 E. C. & M., Nov. 1947). Now, application of such studies will be considered in detail.

A study of extended duration reveals that time is an element which affects both operating and direct labor costs. To assign a dollar and cents value to the effects of extended time, many individual items must be carefully scrutinized. To pave the way for future studies, we shall first deal with a special application: The use of the chart in preparation of "Claims for Additional Compensation."

A contractor signs an agreement to complete an installation within reasonable limits of the normal duration period. Due to no fault of his, the work runs much longer than the time stipulated in the contract. Under such conditions, the contractor is entitled to additional compensation. Before he can entertain hopes of collecting anything, however, he must be able to establish his claims.

When dealing with municipalities, or other public bodies, frequently it is necessary to start a "friendly suit" to collect the claim. On the other hand, claims against individuals or private concerns are usually treated as "extras." Contractors are not always successful in collecting just claims. On many jobs, however, the chances of securing an equitable or compromise settlement are great enough to warrant preparing a case.

Before initiating a claim, the contractor considers the type of contract, the strength of his claim, and the customer. A "sub" to a general contractor seldom, if ever, has a chance to collect anything. Under other conditions, with a strong claim, it is possible to obtain some settlement even though no definite duration time was specified. The attitude of the customer is always of paramount importance.

Initiating and Presenting Claims

Prior to presenting any claim, the contractor meets with the owner and explains his case. To present a bill

without any previous notice would, in all probability, antagonize the buyer. The preliminary notice is given before the completion of the work. *Regardless of the customer's first reaction, the contractor must continue to make the best showing he can on the job.* By the time the contract is completed, the buyer may appreciate such cooperation and have a more favorable attitude toward the claims.

When applying for additional compensation, the contractor should present a detailed, comprehensive listing of all costs, and be able to substantiate any claims made. If the customer is to allow any additional compensation,

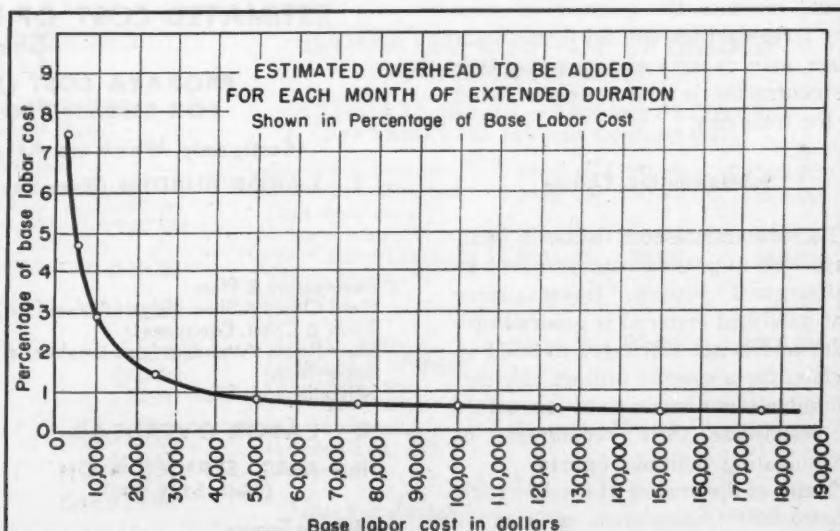


CHART II—Percentage of base labor cost to be added as overhead for each month of extended duration.

ESTIMATED COST OF EXTENDED DURATION

Sheet 1

Job Data

Base Material Cost (Purchase Price)	\$132,000.00
Base Labor Cost (Payroll)	88,000.00
Insurances & Bond	15,400.00
Direct Job Cost (Not Incl. Ins. & Bond)	21,440.00
Overhead Cost	23,380.00
Return	19,780.00
Contract Price	\$300,000.00

Contract Duration Period — 12 Months
 Actual Duration — 19 Months
 Actual Period of Ext. Dur. — 7 Months
 Extended Duration on which additional Compensation is claimed — 5 Months.

Job Data Sheet showing cost analysis of the original \$300,000 contract is the first step in preparing a claim estimate.

he is entitled to know what he is paying for.

A listing of cost items encountered on the usual run of jobs is provided in Chart I. This will serve as a guide. However, each claim must have its individual listing with costs carefully prepared. Insurances and association dues vary greatly in different localities. Other items of cost vary with the type of job and the method of charging. Time-keeping, for example, may be charged directly to the job, as shown in tables II to IV (Chart I) or may be included with overhead as in Table I (Chart I). All down the list, one should exercise the greatest of care. Any irregularities noticed by the customer may cause him to suspect that the contractor is just trying to build up the total cost.

Substantiating Claims

To substantiate cost items, it is always well to present data prepared by disinterested parties. Buyers know that published material is generally reliable and is not fabricated to build up a claim for a specific project. Neither individuals nor institutions can afford to jeopardize their reputations by promulgating fictitious figures.

Many of the studies of the Electrical Contractors' Association of City of Chicago (previously published in "Electrical Construction & Maintenance") are in wide use among elec-

trical contractors. Chart I, which is being used by several contractors, not only serves as a guide, but provides check figures as well.

Preparing The Estimate

As mentioned before, one of the best methods of encouraging a favorable customer reaction to a claim for additional compensation is to have at hand all the facts and figures to justify such a claim. Easiest way to present these data clearly is in the form of an estimate, the development of which is illustrated in attendant Sheets 1 through 3B.

Sheet 1 shows the job data for a project on which claims are to be made. The stipulated time in the contract was 12 months. The actual duration of the contract was 19 months or seven months in excess of the contract period. The claim is to be based on five months instead of seven. The two months tolerance is allowed for two reasons: (1) The "reserve for contingencies and guarantee" is supposed to cover some variation in time; and (2) the case will be received more favorably if the contractor shows a willingness to accept part of the burden.

Sheet 2 is a preliminary sheet to be used for preparing and substantiating the first estimate. The figures are in accord with the contract estimate, and the listing embraces only such items of cost as are affected by extended duration.

Sheet 3 (Estimate I) shows one method of presenting the estimated costs. It follows very closely the method and figures portrayed in Chart I. The prorata cost per month data developed in Fig. 2 are used.

Sheet 3A (Estimate II) lists some known costs taken from the cost records; also other estimated costs. Here we have figures which had to be adjusted to fit the particular job. Instead of having the normal excess labor (See Part III, E. C. & M., Nov. 1947) the records indicated that \$6,000 would be an equitable charge.

Sheet 3B (Estimate III) shows a third listing of costs. Again, costs are established from job records.

In every case the job records must be used as a guide. The bulk of the job may be completed in normal time and only a small part may be responsible for the extended time. During the extended time, it may be possible to remove the engineer and timekeeper, supervision may be low, and the tools required inexpensive. Under such conditions, the cost of extended duration will be low.

Based on the formula established by studies in Chart I (see Note 3, Chart I), the estimated cost for five months extended duration would be:
 $0.10 \times \$300,000 \times 5 = \$12,500$

12

This is less than the amounts shown in estimates I to III (Figs. 3, 4 and 5). It must be remembered, however, that two months tolerance was al-

ESTIMATED COST OF EXTENDED DURATION

Sheet 2

PRORATA COST (JOB & OVERHEAD) FOR \$300,000 PROJECT (See Sheet #1)

(Costs, only, Which are Affected by Extended Duration)

I — LABOR BURDEN (Base Labor \$88,000.00)

Percent of Labor	Total Job Cost (12 Mo.)	Prorata Cost Per Month
Engineering & Plans	2.75	\$2420.00
Field Office & Shop Bldgs. (Actual Cost)		480.00
Tools & Const. Equipment	3.5	3080.00
Store Room Attendant (also timekeeper)	2.0	1760.00
Supervision	2.5	2200.00
Miscellaneous Exp.	2.0	1760.00

II — LABOR OVERHEAD

III — MAT. SERVICE & OH (Mat. \$132,000)

Percent of Material	Total Job Cost (12 Mo.)	Prorata Cost Per Month
Material Service	3.0	\$3960.00
Material OH	5.0	6600.00

Second step is to determine the prorata cost per month for labor and material services and overhead.

ESTIMATED COST OF EXTENDED DURATION

Sheet 3

ESTIMATE NO. I — \$300,000 PROJECT (See Sheets 1 & 2 For Job Data & Job Costs)

Period of Extended Duration — 5 Months

	Normal Cost Per Month (Sheet 2)	Cost Per Mo. of Ext. Dur. Percent of Normal	Cost Per 5 Mo. Duration Dollars
Engineering & Plans	\$202.00	20	\$40.00
Field Office & Shop Bldgs.	40.00	20	8.00
Tools & Const. Equipment	256.00	20	51.00
Store Room Attendant (also timekeeper)	146.00	50	73.00
Supervision	183.00	50	91.00
Miscellaneous Expense	150.00	10	15.00
Labor Overhead	1250.00	40	500.00
Material Service	330.00	10	33.00
Material Overhead	550.00	25	138.00
Excess Labor $\left(\frac{0.20}{12} \times 88,000 \times 5\right)$			\$7333.00
Additional Insurance (Labor)			\$1027.00
Total Estimated Cost			\$13,109.00

NOTE: Based on percentages established by cost studies.

One method of presenting the estimated cost of extended duration claim using normal prorata cost per month data developed in Fig. 2, and some of the percentages shown in Chart I.

lowed. If we allow only one month and use six in the formula, we get:

$$0.10 \times \$300,000 \times 6 = \$15,000$$

12

Extended duration should not be confused with "Shut-Downs". A shutdown job is one which is stopped completely for a period of time. The men are removed, tools and materials removed or stored, and provisions made for protecting work already installed. On such jobs, expenses for the follow-

ing items must be considered:

- (1) Direct Labor Expense
 - (a) Preparing to close down job—storing materials, shipping tools
 - (b) Protecting work and equipment installed
 - (c) Preparing to resume work—setting up tools, checking work installed, etc.
 - (d) Time lost due to change in mechanics
 - (e) Replacing materials rendered

useless during lapse of time

(f) Cleaning equipment and materials

- (2) Material Expense
 - (a) Interest on investment
 - (b) Replacement materials
 - (3) Direct Job Costs
 - (4) General Overhead and Administrative Expense.

The above listing could be much more detailed; however, it is sufficient to show that "shut-downs" have their individual problems and must be treated accordingly. If the job drags when it is in progress, the cost of extended duration has to be included along with all other expenses.

It is apparent that each job must have individual treatment. In addition to the characteristics of the specific job, the opinions of the contractor and the attitude of the buyer must be considered. No two contractors have the same conception of how the problem should be approached. The buyer's understanding and reaction wield a substantial influence. Preparation and presentation of contractors' claims for additional compensation are frequently influenced and guided by owners' representatives who, through their familiarity with project details, are able to substantiate such claims.

So far, we have covered only a special application of the studies shown in Chart I. In the next and final article of this series, consideration will be given to the use of the Chart for other estimating purposes.

ESTIMATED COST OF EXTENDED DURATION — Sheet 3A

ESTIMATE NO. II — \$300,000 PROJECT (See Sheet 1 For Job and Contract Data)

Period of Extended Duration — 5 Months

Construction Engineer	5 Mos. @ \$700.00	\$3500.00
Store Room Attendant (also timekeeper)	4 Mos. @ 300.00	1200.00
Supervision (40 Hrs. per Mo.)	200 Hrs. @ 2.50	500.00
Tools	5 X \$50.00	250.00
Telephone	5 X \$10.00	50.00
Excess Labor (Est.)		6000.00
Excess Insurance		840.00
Excess Cartage & Misc. Expense		150.00
Overhead (excess) 15%		\$12,490.00
Total Estimated Cost		\$14,364.00

NOTE: Based on actual cost records with excess labor estimated.

A second method of presenting estimated cost of extended duration based on actual cost records and estimated excess labor adjusted to fit the job.

ESTIMATED COST OF EXTENDED DURATION — Sheet 3B

ESTIMATE NO. III — \$300,000 PROJECT (See Sheet 1 For Job and Contract Data)

Construction Engineer	5 Mos. @ \$700.00	\$3500.00
Store Room Attendant (also timekeeper)	4 Mos. @ 300.00	1200.00
Job Superintendent	20 Wks. @ 100.00	2000.00
Tools, Constr. Equip. & Constr. Bldgs.	5 Mos. @ 70.00	350.00
Telephone	5 Mos. @ 10.00	50.00
Excess Labor—Shifting Men, Protecting & Cleaning Equipment, etc.	200 Men-Days @ 20.00	4000.00
Excess Insurance		560.00
Gen'l Overhead & Admin. Exp. (25% of Normal)	5 Mos. @ 500.00	2500.00
Total Estimated Cost		\$14,160.00

NOTE: Based on actual cost records with estimated labor (including prorata foreman time) and overhead.

A third method of presenting an extended duration cost estimate based on actual job record data.

Signal Installation Methods

THE installation methods in the signalling and communication field have improved considerably during the past 20 years, particularly where large systems are involved. While the extensive signalling systems have been engineered, the field in general has lagged somewhat behind the communication group. This is largely due to the tremendous engineering and laboratory facilities available, and the thorough planning and study which has been made on this subject. In fact the established standards have become universally accepted.

Most of the problems are centered about the smaller systems which are still to be greatly improved. The methods described in this article will in general pertain to all of the systems and if followed will result in efficiently operated equipment, reduced maintenance and will produce a workmanlike installation.

A complete layout of a system is a prerequisite for a first class installation. The essential details to be considered are as follows:

- (1) The type of system.
- (2) The type and location of the equipment.
- (3) The type, size and number of conductors.
- (4) The size of conduit.
- (5) The type, size and location of the terminal cabinets and junction boxes.
- (6) The type, size and location of the current supply.

A typical conduit layout is shown in Figure 1.

The details for the layout is based upon the following:

- (1) The type of system to be installed is determined by the job and the manufacturer's specification and wiring diagram.
- (2) The type of equipment may be determined by the job and manufacturers' specifications and the location of same would be as shown on the plans and described in the job specifications.
- (3) The type, size and number of the conductors is based upon the location, current load and the wiring diagram.
- (4) The size of conduit for each run is based upon the wiring diagram

Good signalling and communication apparatus deserve well planned and skillful installation. These basic rules and installation methods will help toward trouble-free jobs.

and the number and sizes of the conductors in the specific system.

- (5) The types and the sizes of the terminal cabinets and junction boxes are selected on the basis of the sizes and quantities of conductors, and the locations are selected to produce equitable distribution and ease of testing and locating trouble.
- (6) The type, size and location of the current supply is selected to meet the operating requirements of the equipment, the current load and equitable distribution of the load.

Most of the difficulties encountered in maintaining systems is due to careless installations. While it is true that the majority of signalling and communication systems operate on very low voltages it must be remembered that because of this very fact extra care must be taken. Rigid rules must be observed in making connections, splices and joints, and to prevent the possibilities of grounds, cross-connections, "swinging opens" etc.

The conductors should be of the very best color-coded rubber insulated or synthetic insulated where permitted. Different colors should be used for each common wire. Where large numbers of wires are run from floor to floor or on the individual floors use cables wherever possible. Where the number of wires diminish in size from floor to floor several smaller cables may be used, however, single conductors are frequently found to be more economical. Cable slides through conduit readily and has the added advantage of smaller size conduit.

Wires or cables pulled into conduits on risers are started on the top floor and are fed down to the lower floors. Sufficient slack should be allowed in the form of loops in the terminal cabinets on every floor to permit of proper connections. Each loop should be properly fastened at each point so that it cannot be pulled from the other floors.

Dissimilar colored wires should never be spliced together especially in conduit systems where it is difficult to trace for the entire length. In doing this the color coded wire scheme would be defeated.

Braided cable may be used in conduit located in dry places. The new synthetic insulated cable may be used in dry or damp locations. Lead covered wire should be used in wet locations, underground or on the exterior of buildings. If there are indications that cables have been damaged in shipment, they should be tested for short circuits and grounds.

All splices and joints should be mechanically and electrically secure and prepared as for lighting installations. They should be taped to the equivalent value of the original insulation of the wire.

Conductors at terminal cabinets should be sufficiently long to properly form them and fit them to the terminals. The length depends upon the size and arrangement of the terminal blocks, and the point of entry of the wires into the terminal box. Wherever loose wires occur they should be laced. At locations where dampness may be prevalent, the laced cables should be

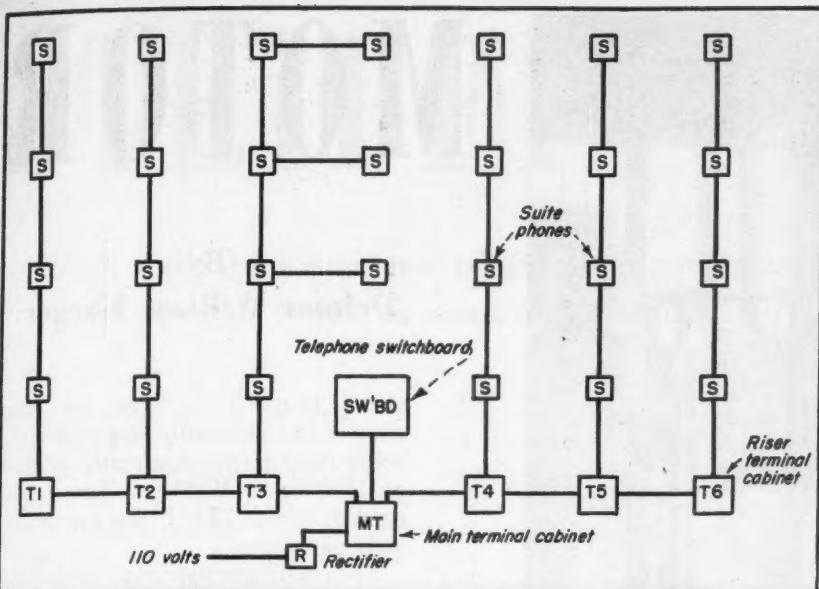


FIG. 1—A typical layout contains a main switchboard, terminal cabinets, phones and distribution system.

coated with an insulating varnish.

Terminal cabinets and junction boxes must be accessible and located in cool dry places. These should be of sufficient size so that the wires may be traced, inspected, connected or disconnected with ease. Each floor terminal cabinet must have sufficient terminals for all of the wires required on its respective floor, plus approximately ten percent for expansion. The main terminal cabinet must have a capacity equal to the total number of wires leading into it from the floor terminal cabinets plus approximately ten percent for expansion.

A blueprint should be located and fastened in each cabinet preferably on the door or cover. It should show the layout of the section of the floor, part of the building or the entire building which it serves, and each terminal should be correspondingly numbered.

All connections should be tightly made since loose wires cause intermittent trouble. Wires should be bent around the terminal screw or post in the direction in which it becomes tight. In practically all cases this means clockwise or to the right. Stranded wires should be tinned before bending. Crimp type lugs of various sizes and types may also be used for terminating wires. These are applied by combination tools which "skin" the wire and fasten the lugs in place. The lugs produce a very satisfactory and workmanlike installation. Various methods of connecting wires are shown in Figure 2.

Wires should be connected to individual terminals wherever possible. For

common and battery wires provide more than one terminal for each in order to eliminate multiple wire connections, and to permit isolation of sections of the system. However, where it becomes necessary to connect two or three to one terminal, copper or brass washers should be inserted between the turns in the conductors to insure better electrical contact and rigid fastening. Where a group of wires are to be commoned, several connected terminals may be used and tied together with bare wire, or a common copper or brass strip. The common wire or strip should be placed under the bottom washer on each terminal post. Where a large number of wires are to be commoned, the best practice is to use a copper or brass bar with the necessary number of screws threaded into same and provided with washers to hold the wires securely in place.

When connecting wires care must be taken not to "nick" the conductors or permit the bare ends to extend from one terminal to another or to touch the steel cabinets, outlet boxes etc., since this will cause shorted, crossed or grounded wires in the system. These troubles are usually very difficult to locate. The conductors should be cut closely to the terminal screws or posts.

Sufficient wire should be allowed for looping and for proper connections to terminal cabinets and equipment. In this way splicing of short pieces of wire is eliminated. In terminal cabinets the wire should be fitted into the space between the inner wall of the cabinet and the terminal blocks, or in the cabinet gutter, properly laced with strong twine, and the individual conductors fastened to the respective terminals. Equipment connections and splices must be taken into account, therefore approximately 6 inches should be allowed for the average outlet of the single gang type and increased as the number of gangs increase. Examples of such outlets would be flush buzzers, return call stations and hospital calling stations. For wall telephones allow 10 to 12 inches. For vestibule telephones allow about 24 inches for the average size unit. Where equipment is hinged, sufficient slack wire should be provided so that there will be no strain on the conductors when the front trims are loosened or the doors are opened.

Conductors must be carefully forced back into the back-boxes or outlet

(Continued on page 154)

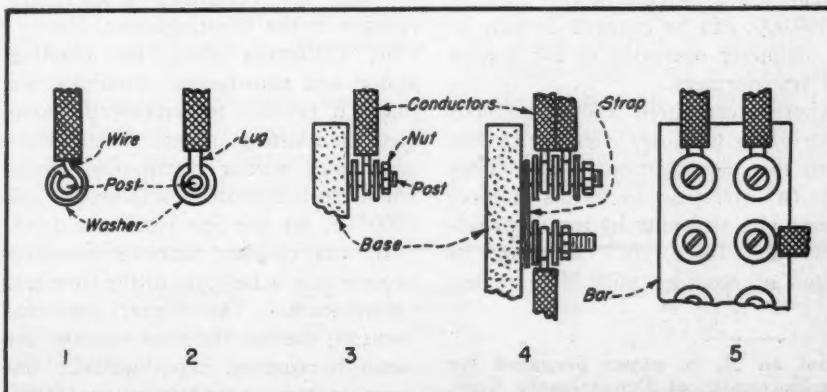
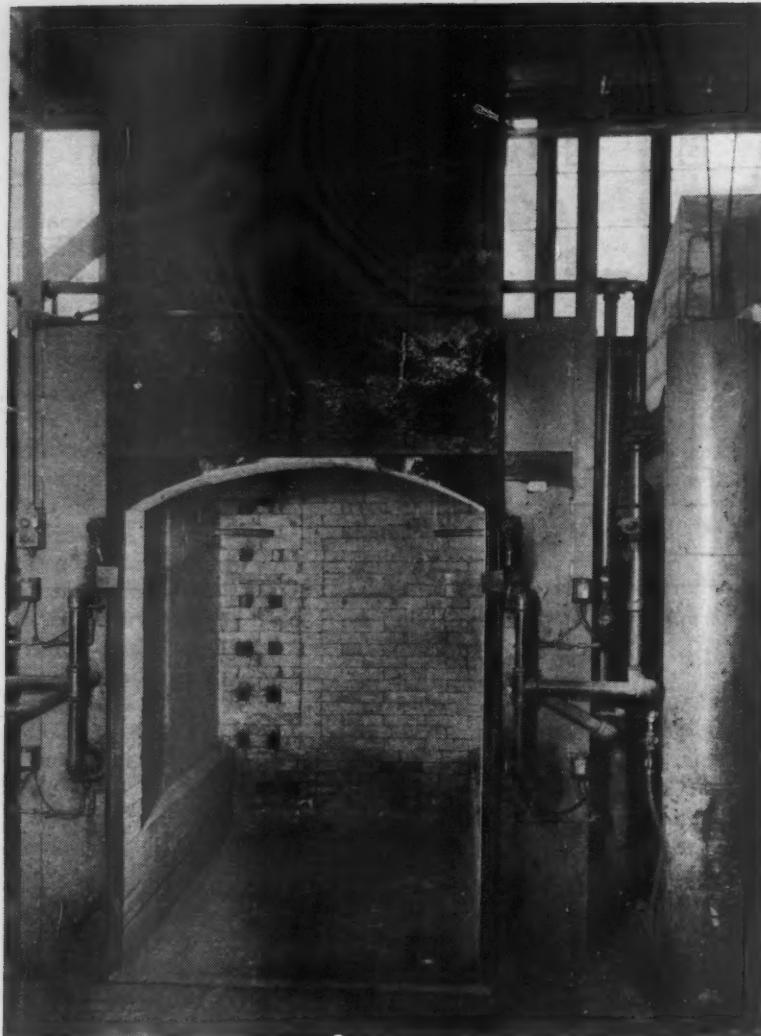


FIG. 2—Where wires are fastened to terminal screws without lugs, wire should be bent in the direction of nut rotation.

MOTOR

By
Delmar William Karger



Experimental oven, designed for roasting insulation, has steel jacket inside refractory brick lining. Forced ventilation system handles pre-heated air.

THE PROBLEM considered here is the stripping of stator and transformer windings from their cores, in relation to the repair of electrical apparatus. Industry, the public utilities, and the consuming public spend \$20,000,000 each year to have major electrical apparatus repaired. Approximately 7 percent of this sum, or \$1,400,000, can be charged directly to the stripping operation of a-c stators and transformers.

There were three known methods of stripping windings from their cores when this investigation began. They are: (a) stripping by means of force alone; (b) stripping by means of solvents and force; (c) stripping by means of roasting plus force. Best

results have been achieved by roasting. When the winding was thoroughly roasted, it was simple to strip it from the core. Unfortunately, windings were not always thoroughly roasted, and secondly, the motor frames holding the cores in position were often ruined by warpage.

Using the controlled temperature furnace in the Westinghouse, Emeryville, California plant, for roasting motor and transformer windings, we found it possible to consistently complete the roasting process. Frame warpage was within permissible limits when the temperature was kept below 1200° F. for the few tests conducted.

It was obvious that the roasting process was a function of the time and temperature. The higher the temperature the less the time required for complete roasting. Experimental variations in temperature between 900° F. and 1300° F. were tried.

Windings were thoroughly roasted

From an M. S. paper prepared for the University of Pennsylvania Graduate School based on research made with facilities and equipment of the Westinghouse Electric Corporation.

at all temperatures when the time element was sufficiently long; however, better roasting was apparently secured at 1100° F. to 1200° F. The actual roasting time at 1200° F. was approximately 45 minutes.

The roasting temperature determines the insulation required on roasting ovens. It was, therefore, the first item to be studied. "Temp Sticks" were used to ascertain the temperatures reached in incinerators used for roasting.

That the roasting temperature could be reduced to 1000° F. if the roasting time was two or three hours in length was quite evident. The time and temperature relationship, however, could not be accurately determined since (a) the roasting equipment observed, such as rubbish incinerators, did not have a uniform temperature; and (b) the temperature was not controlled.

A further consideration of temperature indicated that the large amounts of combustible materials in transformers, and to a certain extent in motors, would tend to raise the temperature above 1000° F., whether or not it was desirable. This combustible material in transformers is entrapped oil plus large amounts of insulating material. When this material in a large load of transformers begins to burn, it actually does raise the temperature above 1000° F.

Temperature Variations

By placing "Temp Sticks" in various positions in incinerators it was noted that there was often a variation of 200° F. to 300° F. inside of the incinerators. Tests of various heat treating furnaces often showed a temperature variation in the work chamber of 5 percent (approximately 50° F. at 1000° F. furnace temperature) whereas temperature variation in ovens equipped with forced air recirculation usually showed a variation less than 10° F. Studies of the heat treating furnaces also indicated that large masses of metal in

STRIPPING

A study of stator and transformer stripping methods shows roasting in special ovens at controlled temperatures gives superior results.

the load tended to cool the furnace in their vicinity.

A practical consideration of this data showed the need of air recirculation if the temperature was to be uniform throughout the work area. This not only would keep the temperature even, but would also increase the rate of heat transfer to the load.

It was apparent that a special oven would have to be built if the roasting process was to be successfully used. Knowing that the time required for roasting would not be important if the roasting process was automatic, a new oven would, therefore, incorporate automatic process control. The man who loads and unloads the roasting equipment can be doing productive labor on other work during the roasting period when automatic process controls are used. The control features believed necessary are described later.

An experimental insulation roasting oven was installed in the Pittsburgh Manufacturing and Repair Department Plant based on the previously mentioned experimental observations and data.

Special Oven Design

The interior of the oven was constructed of refractory brick bonded in fire clay of the same composition as the brick. The brick interior is covered with a steel jacket except for the sheet which is "Transite" in such a manner that an air space of approximately 6 in. is provided between the casing and the interior. On each side of the steel jacket is a 12 in. by 12 in. louvered opening to admit cool, fresh air. The air travels from these openings through the air space between the jacket and brick to openings placed in the brick portion near the roof. The air then goes through the openings into the oven.

It is readily seen how this dilution air serves two purposes; (a) it keeps the steel jacket cool; (b) it dilutes the oven atmosphere to keep the gas and

vapor concentration below the explosive limit. The air is, of course, pre-heated in passing over the relatively hot brick exterior, and, therefore, does not tend to cause the uneven temperature distribution that would occur if cold air were admitted directly into oven work space.

In the rear wall of the oven interior, are openings into a rear section. The air, smoke, and gases pass through these openings into a down draft section constructed of refractory firebrick. It has a cross sectional area of 1 ft. 4 in. by 1 ft. 6 in. The openings into the down draft section were arranged by experiment to provide an even temperature distribution inside of the oven.

From the down draft section, the air, smoke, and gases pass through a refractory firebrick up draft section to the specified power exhaust fan. The exhaust fan is connected to a ventilating stack which leads to the exterior atmosphere.

An over-temperature thermostat was placed in the exhaust stack. This is used to shut off the gas heaters through operation of the solenoid operated gas valve when and if the stack temperature exceeds 600° F.

The oven temperature control pyrometer turns the gas on and off as required to maintain the temperature desired. The thermocouple is placed near the apparatus being roasted. Two 12 in. by 12 in. louvers were placed in the sides of the oven to admit the dilution air.

Each meter on the oven supplied is controlled by a separate 1200° F. pyrometer control instrument. The thermocouple for the right louver was

placed in the right rear of the oven, and that for the left louver was placed in the left rear of the oven.

It was found that windings could be thoroughly roasted even at 600° F. if the roasting time was sufficiently extended. Best results, however, were obtained if the temperature was raised to 1000° F. and then held there for 20 to 30 minutes. It requires one hour and thirty minutes to two hours to reach 1000° F., the time being dependent on the type and size of load placed in the oven.

Frame warpage did not occur since an even temperature distribution was obtained; however, motor stators having the core welded to the frame broke loose due to unequal expansion rates for the core and frame. The core did not get out of position during the roasting process even though the weld was broken. It could, therefore, be repaired by "tack welding" the core to the frame after roasting.

Time Studies

Time studies reveal that productive labor reductions experienced for 10 kva. transformers and 20 in. bore, 10 in. long stators are typical of those for other sizes of similar apparatus and approximately equal on a percentage basis. The actual time values and percentage reductions are shown below.

The total repair time per unit for the stator includes its assembly with its related parts into a complete motor.

The experiments prove that roasting of stator and transformer windings for stripping can be successfully

[Continued on page 152]

Item	Incinerator Roasting	Oven Roasting	Saving per Unit	Reduction Per Cent Per Unit	Total Repair Time per Unit	Per Cent Reduction in Total Time
10 kva. transformer	.25 hrs.	.067 hrs.	.185 hrs.	73	10.7 hrs.	1.71
20" bore 10" long stator	1.00 hrs.	10 hrs.	.90 hrs.	90	31.4 hrs.	2.86



Original condition of card-punch room, Bureau of Internal Revenue, Washington, D. C., selected as test room for two-year environmental study.



Same room after relighting, repainting ceiling and side walls, refinishing business machines and desks, and re-flooring with lighter color material.

Improved Lighting Increases

Federal agencies complete two-year joint study on the influence of lighting, eyesight, and environment upon work production in an office.

BETTER visual conditions result in increased work in an office. Improved lighting, proper environment, and use of correct glasses when needed, definitely increase worker morale. Such advantages are adequate to more than offset the cost of providing these better conditions. These and other conclusions have been reached by the Federal Government, after a carefully planned and efficiently managed two-year study of the subject was made.

The primary purpose of this study, according to W. E. Reynolds, Commissioner of Public Buildings, was to find out what happened to the production, welfare, and morale of a group of office employees when their working conditions were improved so they could see better. Additional objectives were to get engineering data needed for any future program for improving Government offices, and to get statistics and other facts that would be useful to industrial management, when they are deciding to undertake a program for improved environment in which their employees work. Results of the study were made public December 1, 1947 in a report on "The Influence of Lighting,

Eyesight, and Environment Upon Work Production", which was prepared and released by the Public Buildings Administration, Federal Works Agency, Washington, D. C.

In 1945, a pilot experiment was advocated by Charles P. Tolman, consulting engineer for the National Society for the Prevention of Blindness, when he appeared before the Council of Personnel Administration, under sponsorship of the Civil Service Commission. A card-punch subsection of the Bureau of Internal Revenue, Room 1515-33 of the Internal Revenue Building, Washington, D. C. was chosen for the experiment. The entire project was then turned over to the Public Buildings Administration and the Public Health Service for planning and execution.

PBA engineers and research scientists of the Industrial Hygiene Division, PHS, immediately worked out a program for this project which would furnish the necessary data required for analysis of the subject. They prepared a "Time Table of Activities" (Table I) based on their analysis of the program and arranged for the participation of other organizations whose services were needed.

To get information about production and morale, PBA and PHS had to study the factors that affect the ability of the employees (all girls) to see the tax forms, punch cards, and keyboards of their machines. Elaborate "before and after" records had to be kept for each employee. The Bureau of Internal Revenue cooperated by making these records and turning them over to PHS for analysis.

The eyesight of the girls was the first factor to be considered. PHS refracted the eyes of the girls in the room, and the National Society for the Prevention of Blindness supplied the glasses that were given to every girl who needed them. A study was made of the efficiency of each girl in relation to the sharpness of her sight for the task she was doing.

Lighting was the second factor considered. PBA engineers had to decide what quantity and quality of light was required, and the type or types of light sources best suited. They also had to study the original cost of the new lighting installation, and its maintenance cost. They had to consider the old wiring circuit capacity, and the cost of increasing this capacity, if it



Original condition of lighting and painting resulted in brightness contrast ratios in excess of 100 to 1.



Eyesight of all workers was tested at beginning of study and vision corrected when needed.



Final conditions provide comfortable brightness ratios and contribute to increased worker efficiency and morale.

Production

By Berlon C. Cooper

should prove necessary. They further had to study the adaptability of any new lighting installation made to general use in other buildings.

The third factor considered in this study was the environmental appearance of the test room, and how it might be changed to improve the morale of the girls and at the same time provide efficient reflecting surfaces for the lighting.

Results of the program were appraised by PHS by analyzing production rates, percentages of errors, dispensary records, and absenteeism, and by tabulating the answers to a questionnaire. Individual reports from supervisors were also obtained, to determine whether the improvements helped them in their work.

In order to obtain data for purposes of comparison, the study was made in successive stages, and referred to as "Conditions 1, 2 and 3." "Condition 1" was the original condition of the room before any changes were made. "Condition 2" was with the room unchanged, but with new lighting fixtures installed. "Condition 3" was the final condition of the room after new lighting fixtures had been installed,

- TIME TABLE OF ACTIVITIES
in Study on
Influence of Lighting, Eyesight and Environment on Work Production**
1. **Preparatory Work—July 17 to September 1, 1945**
(a) Check of employees' eyesight. October 1 to November 15, 1945. Made by Public Health Service.
(b) Survey of existing conditions in card-punch room. Made by Public Buildings Administration, Public Health Service, and Bureau of Standards.
(c) Development of plans and specifications. Explanation of the project to the card-punch employees, to enlist their cooperation.
 2. **Schedule of Changes and Survey Periods**
(a) Correction of the vision of the employees. Adjustment period, October 1 to November 15, 1945.
(b) Survey of productivity and health records for one month. November 15 to December 15, 1945.
(c) Correction of lighting. Adjustment period. December 15, 1945 to January 7, 1946.
(d) Survey of productivity and health records for one month. January 7 to February 7, 1946.
(e) Correction of color and brightness contrasts. Adjustment Period. February 7 to March 1, 1946.
(f) Survey of productivity and health records for one month. March 1 to April 1, 1946.
(g) Reaction of employees obtained by questionnaire. March 27, 1946.
(h) Six-month survey of production, for comparison with similar period of previous year. April 1 to September 30, 1946.

and after painting of walls and ceilings had been completed for brightness control, new floor of lighter color had been installed, and machines and desks had been repainted in new, lighter colors.

The space under study contained 3735 square feet. It consisted of ten bays, each 15 ft.-6 in. by 24 ft., with a 16 ft. high ceiling. Original finish of interior was a painted tan wainscot 8 ft. high, with acoustic tile covered walls, ceiling and beams which were

a light tan when installed originally, but which had become badly soiled through use. The floor covering was dark brown mastic. The room contained 86 cardpunch machines plus chairs, cabinets, racks, tables and supervisors' desks. Original lighting consisted of two fully direct type fixtures per bay, each using a 300-watt incandescent lamp. The general effect was dim and depressing, with an average of 10.5 footcandles on the working plane.

TABLE II

WHY SEMI-DIRECT LUMINARIES WERE SELECTED			
General class of luminaries	Totally direct (all types, including control lens, enclosed, and suspended types)	Semi-direct and direct-indirect	Indirect and luminous indirect
Quality of illumination (distribution, absence of shadow, etc.)	Poor ceiling fixture brightness relation. Shielding angle poor in most fixtures. Many sources necessary to avoid shadow.	Substantial upward component would be desirable to reduce fixture ceiling brightness contrast ratio.	Would best provide quality of illumination, soft shadow and best ceiling fixture brightness relationship of all fixtures.
Performance under final brightness conditions.	Substantially same as original.	Would provide best balanced performance under old and new conditions.	Would show most gain with ceiling repainting, if possible to provide white ceiling.
Architectural fitness	Industrial fixtures were out of place architecturally.	Suitable commercial fixtures are available.	Suitable appearance.
Cost	Industrial type reasonable in price.	Acceptable.	Would require highest cost for installation and maintenance of all fixtures.
Remarks	Unless many fixtures overlap, multiple shadows exist. Dark ceiling was undesirable psychologically.	Ultimate darkening of tile ceiling and walls would not affect major downward component of light. Upward component should be great enough to illuminate ceiling and provide diffuse component to reduce shadow.	It was impossible to provide white ceiling and retain acoustical efficiency of ceiling tile. Tile presents difficult cleaning problem even when not painted white.

TABLE III

ILLUMINATION EFFICIENCY IS INCREASED		
Condition	Watts per Sq. Ft.	Footcandles per Watt per Sq. Ft.
Original	1.61	6.53
After relighting	2.54	16.73
After painting	2.54	21.02
After three months	2.54	18.01

TABLE IV

	Room Condition		
	Original	New Fixtures	Final
Greatest brightness in normal field of view (Foot Lamberts)	1195	47	20
Lowest brightness in normal field of view (Foot Lamberts)	.4 to 3.6	.9	6.3
Maximum ratio on work and machine	100 to 1	40 to 1	4.7 to 1
Maximum ratio in operator's normal field of view	varies and over	42 to 1	8 to 1

In planning for the relighting, general classifications of fixtures were considered as to quality of lighting, architectural fitness, best performance under the proposed brightness changes (repainting), and cost. From this analysis, (Table II), which indicated that semi-direct luminaires should be used, a more detailed investigation of several semi-direct type fixtures was made. Cost figures "per footcandle per 100 square feet per year" were developed on the basis of amortization in 15 years, both for the original condition and for the proposed improved condition. Distribution curves and point-by-point calculations were studied to determine which fixture had the most desirable proportion of direct and indirect lighting.

The "cost per footcandle year per 100 sq. ft." for three semi-direct fixtures studied varied from \$0.537 to \$0.44. The fixture providing the lowest unit cost of \$0.44 was selected. It is a four foot long semi-direct pendant unit containing two 40-watt, 3500 degree white fluorescent lamps, mounted

on either side of a central reflector. It is open on top and shielded on each side by a translucent plastic panel and by cross louvers below. It directs approximately 36 percent of its light upward, and 41 percent downward. These units were installed in 20 continuous rows, 7 ft.-9 in. on centers, five 4-foot units to a row, suspended on 24-inch stems, with the rows normal to the length of the room and paralleling beams. Installation was completed December 30, 1945 and constituted the second stage of the project.

Following color recommendations of Faber Birren and Company, New York color consultants, and finishes for the acoustic tile ceiling and side wall as recommended by the Bureau of Standards, the room was completely color conditioned for brightness control and to provide a more uniform background for the area in the operators' normal field of view. Colors used, including reflectances are shown below.

Card punch machines, housings, writing shelf, etc., medium gray green, 23 percent reflectance.

Card punch machines, chassis and legs, dark gray green, 15 percent reflectance.

Walls, up to dado (8 ft.); light blue green, 50 percent reflectance.

Trim, doors, sash, furniture, at walls; blue green, 15 percent reflectance.

Acoustic tile ceiling, beams, upper walls; off white, 70 percent reflectance.

Floor; tan marbleized linoleum, 33 percent reflectance.

Furniture, desks, chairs, tables; medium gray green with light linoleum tops, 23 percent reflectance.

Painting and color conditioning of the room and furniture, etc., constituted the third stage of the study. Complete readings of lighting intensities and brightness ratios were made under final conditions of new fixtures and new painting. Results are shown in Tables III and IV. Footcandle readings were also made again after three months operation, to obtain "in-service" conditions.

Costs of the study, exclusive of [Continued on page 150]

Motor Maintenance

An efficient motor service company must be organized to render preventive maintenance and make fast emergency repairs.

By William J. Wheeler
*President, The Maintenance Company, Inc.
New York City*



It is said that some Chinese doctors charge annual fees for keeping clients in good health. Should a client become ill, the fee is temporarily waived, so it is obviously sound business for the doctor to protect those under his care from sickness. A close parallel is to be found in the operation of an efficient maintenance company. If a maintenance contract is to be profitable, major repairs must be kept at a minimum and breakdowns must be eliminated. This can be accomplished only when equipment is maintained in a trouble-free condition and minor faults are discovered and corrected before they become serious. Major repairs reduce the profits of the maintenance organization and reduce the output and service of the customer, so it becomes mutually advantageous to both parties when maintenance is preventive rather than corrective.

But even with studied care, electrical and mechanical equipment will sometimes fail due to undetected structural weaknesses, unpredicted overloads, unusual or severe operating conditions, abuse or contributory causes such as floods or external fires. To minimize the extent of these resultant breakdowns, repairs must be prompt. Frequently the replacement of a motor, controller or an entire assembly is the best solution for restoring service in the shortest period and, for this reason, a maintenance company should have a large stock of spare motors and a complete stock of replacement parts.

Listing the progressive steps taken in answer to an emergency call from

one of our customers will indicate some of the procedures followed in an effort to speed service.

When the emergency phone call is received at our office, the operator instantly refers the call to a service dispatch clerk who rapidly fills out a form, including the time of the call and the nature of the work. At the desk is also located a file containing cards for all customers having maintenance contracts. These cards include the customers' names, addresses, phone numbers, equipment included, the physical characteristics of the equipment and the type of contract in existence. Regardless of whether or not the plant is covered by a maintenance contract, the dispatch clerk calls the inspector-mechanic serving the customer's district. This field man proceeds directly to the location of the emergency, diagnoses the trouble, reports the nature of the required work to the central office by phone, and specifies the equipment and materials needed for the repair. Should a spare motor be required, the stock room is notified by inter-office phone, the unit is taken from stock, carried by dolly or overhead crane to the shipping room and dispatched to the jobsite by truck. In the meantime, the inspector-mechanic on the job dismantles the old motor or removes the defective parts so that, when our delivery truck arrives, minimum time is required to make the necessary replacements and restore the equipment to service.

Should the emergency call be made at night, a skeleton night office staff

follows the same procedure and the inspector-mechanic living nearest to the trouble area is notified. If the shop is not in operation on that particular night, a stock keeper, truck crew and repair team is summoned by phone to rush the needed work.

In the majority of cases, the trouble is not of a serious nature and the mechanic sent to the job can either correct the difficulty immediately or make a temporary repair to restore service until a permanent repair can be effected.

Under a yearly maintenance contract, a customer's motors and control devices are inspected approximately bi-weekly. Worn brushes, contacts and parts are adjusted or replaced. Motors are lubricated and cleaned. In addition, all necessary repairs are made to motors, including rewinding of armatures, fields, stators or rotors. Commutators or collector rings are repaired or replaced, as are worn bearings. Should trouble develop between regularly scheduled inspection and maintenance visits, emergency service is rendered as an integral part of the contract without additional charges.

To give the utmost in service, a maintenance organization should have a force of trained inspector-mechanics, skilled supervisors and first class electrical and machine shops. The equipment in our shop includes coil winders, spreaders, dipping tanks, testing dynamometers, lathes (up to 4-foot swing), milling machines, drill presses, forge and welders, a 150-ton press and two

(Continued on page 118)

THE NATIONAL ELECTRIC "800" Floor Box-and Service Fittings

FOR CONVENIENCE OUTLETS IN THE FLOOR—FOR LIGHT, POWER, TELEPHONE, SIGNAL CIRCUITS
STEEL FOR PERMANENCE—
GROUNDED FOR SAFETY



The "800" FLOOR BOX may be used with any steel conduit or steel underfloor duct to provide auxiliary outlets in isolated areas, or for a complete underfloor distribution system.

IDEAL FOR: Banks . . . Hotels . . . Commercial Buildings . . . Offices . . . Lobbies . . . Open Aisles . . . Show Windows.

EASY TO INSTALL—EASY TO ADJUST

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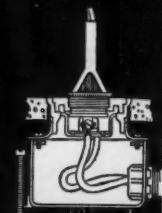
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SERVICE FITTINGS
FOR LIGHT AND POWER

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Floor-box receptacle and waterproof plug.

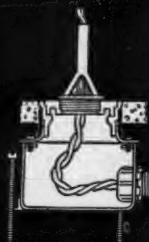


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SERVICE FITTINGS FOR
TELEPHONE, SIGNAL AND
BELL SYSTEMS

NO. 831

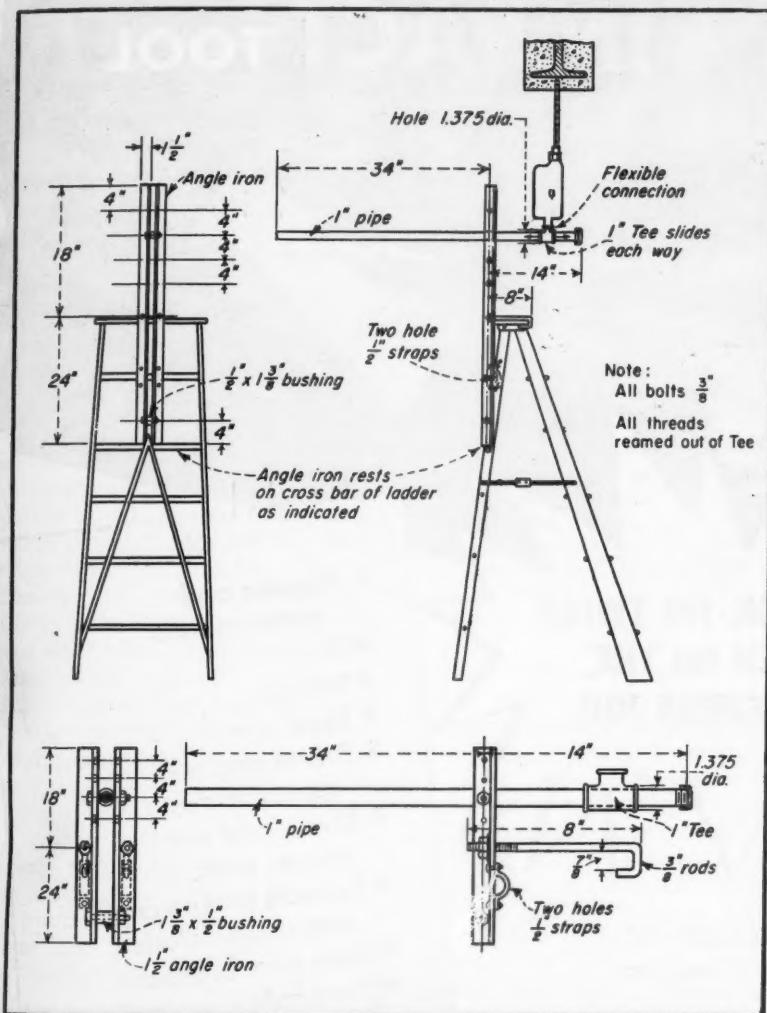
Floor-box waterproof sheath.



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BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

Practical Methods



Drill is supported by threadless tee which slides freely along short end of pipe lever. Lever is pivoted on angle iron frame which fastens to step ladder. Overhead drilling is more accurate, faster and less tiring when this ladder electric drill press is used to support the drill.

Ladder Frame For Overhead Drilling

CONSTRUCTION

The application of the lever principle can be advantageously used to increase the accuracy and efficiency of overhead drilling and decrease the effort necessary to support the drill as well as to apply upward pressure. Frank Ferreri of Brooklyn, New York, constructed an assembly which he calls a ladder electric drill press and which proved a labor saving aid in drilling and tapping a large number

of holes in the lower flanges of overhead I-beams. The assembly is also of assistance when drilling into concrete ceilings.

As illustrated, the assembly is supported by a step ladder and consists essentially of two vertical 40-inch long $1\frac{1}{2}$ -inch angle irons and two anchor hooks for securing these vertical angle irons to the top of the ladder. The lever is a 4-foot length

of 1-inch pipe, pierced by a pivot bolt 14-inches from one end. On the shorter end of this lever, a 1-inch tee, with threads removed, slides freely along the pipe. Four holes on 4-inch centers, drilled through the upper facing legs of the vertical angles, permit the positioning of the lever fulcrum at any one of the four heights. For most effective operation of the drill, this fulcrum height should be such that the lever is approximately level when the supported drill is just in contact with the surface to be drilled. The 1-inch, freely sliding tee is positioned directly beneath the location of the proposed hole and the stock of the drill is supported by the turned up neck of the tee. In operation, the drill operator stands on the ladder, places the drill in position and guides it during drilling. A second operator applies downward pressure to the end of the lever furthest from the drill. By lever action, the drill is forced upwards against the ceiling or beam and the hole is drilled quickly and accurately.

Fiberglas Insulation For Forgings Plant

INSULATION

Motor windings of organic material have been replaced by fiberglas electrical insulation in the Pittsburgh Forgings Company plant at Coraopolis, Pennsylvania. In those cases where rewinding has been accomplished, it has been found that insulation life has increased over 350 percent.

Operating conditions, under which 150 ten-horsepower blower motors are used as blast fans to heat forging furnaces, are severe. Located on the top edges of open furnaces, with 1800 degree F interior heat, the motors are subjected to high heat at all times. In addition, due to the failure of the gas to always ignite immediately when furnaces are started, frequent explosions result in flames sweeping over the blower motors, burning grease from the housings. Still another factor had to be considered, since the building in which the furnaces are lo-

AMAZING ALL-PURPOSE ELECTRIC IMPACT TOOL



**NO KICK - NO TWIST
EVEN ON THE
TOUGHEST JOB**

Drilling with a 1" wood auger. Notice large chips. Action photo taken at f32 and 1/5000 sec. electro-flash.

The sensational new Ingersoll-Rand Electric IMPACT Tool amazes everyone with the easy way it handles tough jobs.*

The patented "rotary impact" mechanism that gives this outstanding performance also assures trouble-free service by permitting the motor to run even if the spindle is completely stalled!

AMAZING! It's reversible . . . full power in either direction . . . runs on 110 V ac-dc.

AMAZING! With standard attachments, you need only one Impact Tool to do all operations.*

Call your nearest jobber or distributor for a demonstration... run it yourself...you'll be amazed!

- Applies and removes nuts
 - Drills
 - Reams
 - Taps
 - Drives and removes screws
 - Drives and removes studs
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AMAZING! It saves up to 90% of the time on nut-running operations alone.

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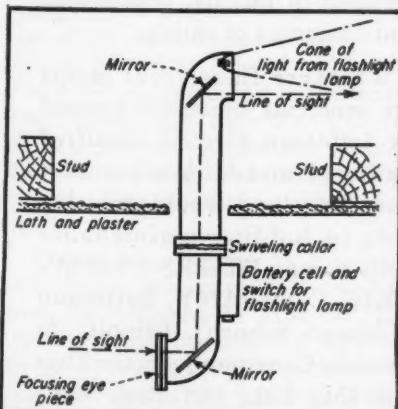
cated has open-eave construction and extreme moisture conditions generally exist.

To combat these tough conditions, a number of motors were rewound with Owens-Corning fiberglass materials more than a year ago and these units are still operating satisfactorily. Prior to shifting from standard organic materials, motors required rewinding every three months. The actual increase in rewinding with fiberglass was approximately 10 percent higher than formerly on a cost basis. As other motors burn out, they are being rewound with glass.

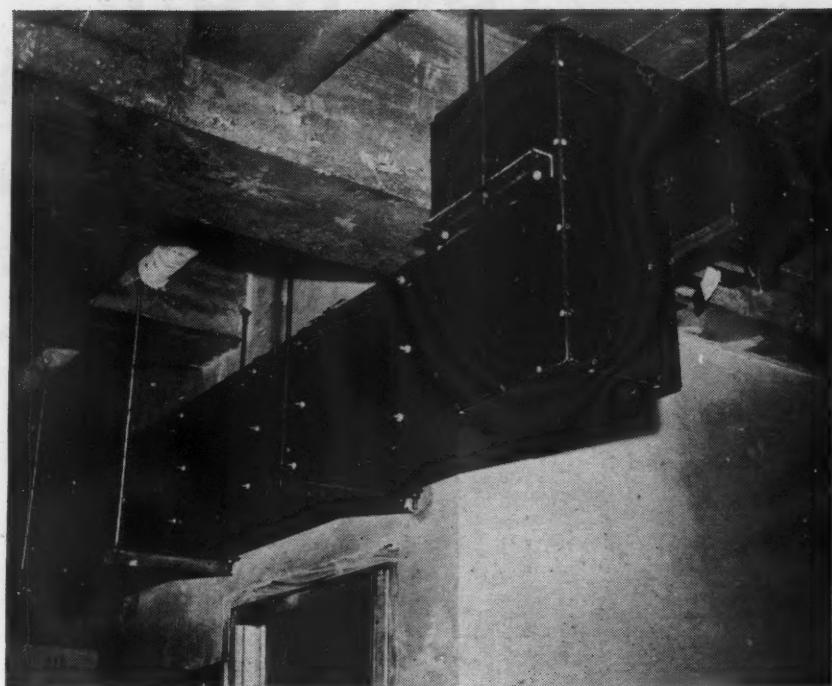
Fishing With a Periscope

CONSTRUCTION

To locate stray cables or obstructions in existing walls or ceilings, an electrician often has to spend considerable time in fishing or has to make sizable openings in finished plaster surfaces to accomplish his task. Joe Chamides of Brooklyn, New York, suggests that the use of a small periscope fitted with a flashlight lamp and battery makes it possible for the electrician to see exactly where the snake is headed or where the obstruction is located. It also makes it possible for one man to direct a second worker who is fishing towards him. By using the small periscope and light, a hole in any wall need not be larger in diameter than an inch and the worker is permitted to see all utility services, cables and other equipment behind the finished surfaces.



Simplified sketch of periscope, used for fishing or locating hidden obstructions, shows positions of mirrors, focussing eye piece, flashlight lamp and battery. Swiveling collar permits upper section to rotate about common axis. Hole in plaster need not be larger than an inch in diameter.



Triple-offset cross-over of 2,000-amp., 250-volt, 4-pole busduct, hugs beams and wall at The Dayton Company Store in Minneapolis. Kvalsten Electric Company, Minneapolis contractors on the project, used angle-iron and rod trapeze hangers to suspend the duct connection between two vertical risers extending up through the building. Angles near wall were grouted in to provide snug fit.

Periscopes can be obtained measuring 8 inches in length and $\frac{3}{4}$ -inch in diameter with a swivelling collar to permit one section to be rotated about a common axis. The section that is inserted into the wall or ceiling hole is equipped with a mirror and a small flashlight lamp, lens and reflector. The section remaining outside the hole contains the eye piece, a focussing wheel which indicates on an adjacent scale the approximate distance to any object in focus, a second inclined mirror and the battery cell with switch for operating the flashlight lamp. By rotating the upper section, the light cone and the line of sight sweep in an arc to view what is hidden by the wall. When the lost cable or hidden obstruction is located, the focussing wheel is adjusted to bring the object into sharp focus. Knowing the exact line of sight between the hole and the object sought, and knowing the approximate distance to that object, the time required for fishing is reduced to a minimum.

Customer Contact

PROMOTION

H. N. Crowder of Allentown and Easton, Pa., is constantly alert for

unique ideas for promoting good will between the company and customers. One such idea is to occasionally send out letters with the single purpose of promoting contractor-customer friendship.

Over a period of years, a list has been compiled of customer birthdays and a recent birthday letter was sent to this special listing. Samples of the customers' handwriting, signatures or written notes or letters, were first analyzed by a nationally known handwriting expert and a character analysis prepared for each individual. As birthdays rolled around, the customer would be surprised to receive a sample of his own writing, an analysis, and a friendly letter from the Crowder brothers, reading:

"One of the things we enjoy most is the opportunity of wishing you a happy birthday."

"Speaking of the future, some folks have failed to see 'the handwriting on the wall'. Well, we aren't sending you a wall for your birthday but are enclosing some handwriting of personal interest to you. This is not a case of make-it-sound-good-for-a-customer-of-mine stuff, but straight-from-the-shoulder without soft soap or taffy."

"So here you are, with no holds barred, and may you have the happiest birthday ever."

FOR HIGH, LOW, or Average Ceilings

(Photo below courtesy of The Edwin F. Guth Company)



BETTER LIGHTING

Mercury lamps require closely coordinated Transformers to govern the current through the starting period and operating cycle since a great change in internal resistance takes place.

Correctness of design of Jefferson Transformers has been amply demonstrated in factories, mills, warehouses, gymnasias in all parts of the country. Quality control of all steps of Transformer manufacture under our own roof insures long trouble-free service. Specifying Jefferson Electric Transformers for your mercury lamps is a sure way of getting top lighting performance.

For fluorescent lamps used for



Lower Maintenance

Jefferson Electric Transformer for use with high intensity Mercury Lamp for high bay lighting. Made in all standard capacities, single and two-lamp types.



Jefferson Ballasts are available in two-lamp 40-watt sizes designed to bring leads either from ends or bottom, the latter particularly suited for direct mounting, on narrow wiring channels or fixtures. Available in capacities and types for all commercially made fluorescent lamps.

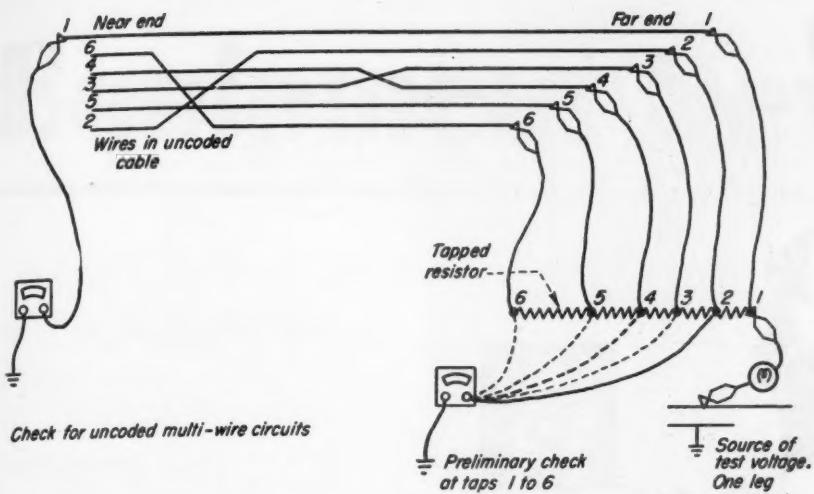
low or average ceilings, precision made and mass produced, Jefferson Electric Ballasts are selected by the most experienced men in the lighting field for their unmatched quality, uniformity, and exactness of rating.

Wherever fluorescent lamps are used, the quietness assured by Jefferson Electric Certified Ballasts is an additional comfort and their long trouble-free life aids in holding maintenance costs down. JEFFERSON ELECTRIC COMPANY, Bellwood (Chicago Suburb), Illinois. In Canada: Canadian Jefferson Electric Co., Ltd., 384 Pape Ave., Toronto, Ont.

MERCURY LAMP TRANSFORMERS



FLUORESCENT LAMP BALLASTS



Tapped resistor is connected to individual wires of uncoded cable or conduit. One end of resistor is connected to voltage source and taps are progressively touched by ungrounded lead of voltmeter. Voltmeter readings are taken at far end of cable by same method, and wires are traced by matching the two sets of voltmeter readings.

Resistance Marks Wires in Uncoded Cable

WIRING

The individual wires in a multi-wire uncoded cable or conduit can be positively identified by following a method suggested by A. F. Stilson of Galesburg, Illinois.

Various points along the length of a resistor are tapped and these taps are connected to the wires in the cable or conduit to be traced and identified. The taps are numbered consecutively from one end of the resistor to the other. One end of the resistor is connected to a voltage source, such as the ungrounded leg of a lighting circuit (preferably through a 50-watt lamp) or a B battery, and the other side is connected to a ground. A preliminary voltage check is taken, connecting the taps of the resistor, one at a time, to one of the leads from a voltmeter. The other voltmeter lead is grounded. The voltage will naturally decrease in proportion to the distance between the resistor taps and the voltage source. These various voltages are noted.

Taking the voltmeter to the other end of the cable or conduit, one lead from the voltmeter is grounded and the other lead is connected progressively to the individual wires to be checked. Again the wires and their corresponding voltages are noted. With the exception of a small voltage drop due to the length of cable, the two sets of voltage readings should contain the same readings. By matching these readings the wires can be positively traced and the ends tagged for later reference.

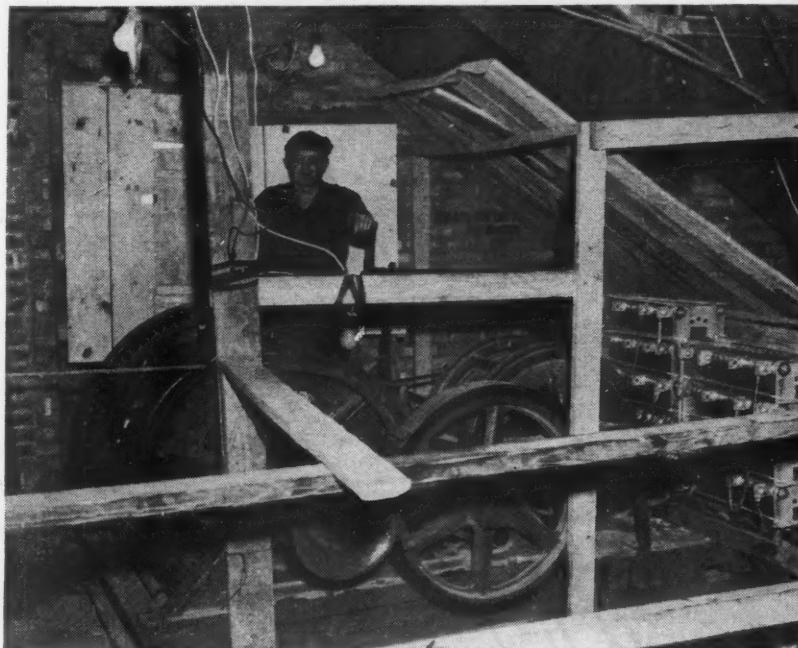
The resistor should be from one to several times the total resistance of the voltmeter used and tapped so that the various steps are approximately equal and clearly distinguishable. One such resistor is a radio bleeder resistor of proper size equipped with movable taps that can be readily adjusted.

Ventilating Conduit

WIRING

From England, one of our readers offers a suggestion for eliminating condensation from conduit runs. W. E. Warner of Woodford Green, Essex, mentions that long pipe runs, especially in certain positions or locations, have a tendency to accumulate condensation. This condition sometimes becomes so pronounced that wiring insulation deteriorates and resistance is lowered to the point where short circuits occur.

Such runs of conduit can be ventilated and condensation can be eliminated by inserting a Tee in the line where the moisture condition is most severe. The Tee is composed of a short (6-inch) section of conduit of the same diameter as the main run and threaded at both ends. A short section of $\frac{1}{4}$ -inch pipe is connected to a tap in this 6-inch conduit, forming the Tee. When connected into the main conduit run, the $\frac{1}{4}$ -inch pipe is turned downwards into a container filled with calcium chloride or some other moisture-absorbing agent. Moisture inside the conduit is thereby eliminated and insulation of wiring is protected from deterioration and early breakdown.



Electric winches do the hoisting and elevator chores during construction of the new 18-story Terrace Plaza Hotel Building in Cincinnati, Ohio. Typical of the six or seven in use is this unit powered by a 100 hp, 3-phase, 220-volt, slip-ring motor. Winch operates a materials elevator from sub-basement to 14th floor. Bertke Electric Company connected these for Frank Messer & Sons, Inc., general contractors on the project.



Fashions CHANGE...
in circuit protection, too!

Time was when the lady of the house would plot a dark and perilous course to the cobwebby cellar to explore its electrical intricacies... cross her fingers—and hope for the best.

Today... when current fails... she knows just where to look! She goes straight to the accessible Federal NOARK multi-breaker... flicks a

convenient switch... and, presto! ...the world lights up again!

Simple, reliable, good-looking Federal NOARK multi-breakers are available in a complete range of ampere ratings — for both indoor and outdoor applications.

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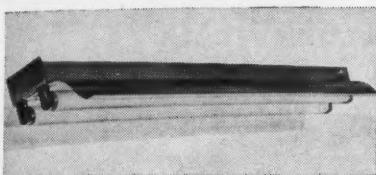
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THERMAL
MAGNETIC
MULTI-BREAKER



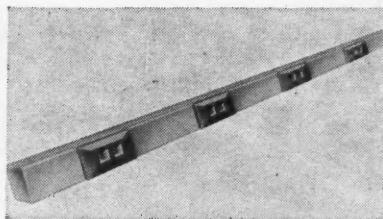
Equipment News



Fluorescent Unit

A new all purpose industrial fluorescent unit, designed to deliver high-intensity, comfortable working light with rugged durability has been announced. The new Model No. 2098 uses two 40 watt fluorescent lamps mounted in a reflector designed for maximum lighting efficiency. The unit features strong steel wireway construction, with brackets and knockouts for chain suspension, rigid rod mounting or surface mounting, singly or in continuous rows. Reflector is 11 inches wide, finished in white enamel; wireway channel is gray. It is equipped with latest type ballasts, sockets and FS-4 starters. Operates on 110-125 volts, 60 cycles a-c. Mitchell Manufacturing Company, 2525 Clybourn Avenue, Chicago 14, Ill.

runway when installing or after relamping. It can be used on either 6.6 ampere series circuits or 120-240 volt multiple circuits. Westinghouse Electric Corporation, Pittsburgh 30, Pa.



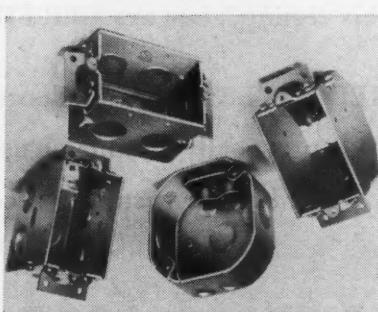
Wired Plugmold

Ready-to-install prewired Plugmold in 3 foot and 6 foot lengths, with outlets wired in position on either 6 in. or 18 in. centers is now available. Dimensions are 9/16 in. deep by 13/16 in. wide. Convenience outlets may be added or relocated to suit the particular needs of the user. All of the fittings in the No. 1900 Plugmold line are usable with it. Each length is furnished with a connector block at one end and a No. 1910B blank end fitting on the other end, and wired for easy connection to the adjoining section. Each length is furnished with a cover coupling. It has been designed for use in homes, stores, schools, hospitals, offices, and may be used in combination with standard No. 1900 Plugmold system, or interconnecting with other Wiremold surface metal raceway wiring systems. The Wiremold Company, Hartford 10, Conn.



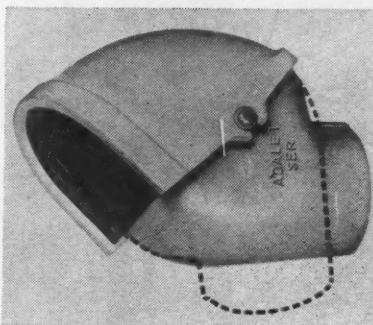
Marker Light

A new day or night marker light for any class of airport, large or small, has been announced. Its brightly colored cone identifies the runway or strip in daytime while the light at the top provides an elevated marker at night. The lens assembly is designed to give asymmetric light distribution with the major portion of the light in line with the runway. Lenses and frame are indexed and the entire assembly can be oriented by rotating lens and cone support on the shaft. Rifle sights enable aligning the unit with



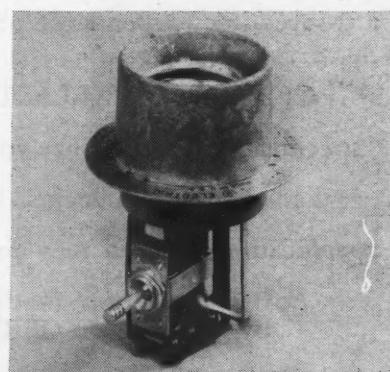
Switch and Outlet Boxes

These electric switch and outlet boxes are fabricated from aluminum. They have all the advantages of steel boxes, it is claimed. They have REA approval since they will not rust or corrode. The new aluminum boxes have been approved by Underwriters Laboratories, Inc. W. T. Driver, Minneapolis, Minn.



Fitting

A new service entrance fitting with reversible head has been introduced. It is so designed that it can be used in the conventional upright manner, or the hub may be reversed in such a way that the wires enter and leave the service head in the same plane. The entire assembly is held together with two bolts. The insulating covers are made of reinforced phenolic sheets with machined holes and edges. Body and head are made of cast aluminum. Available in 2½ in., 3-in., 3½ in., and 4-in. pipe sizes. The Adalet Manufacturing Company, 1450 East 49th Street, Cleveland, Ohio.



Lampholders

A new line of the "Trigger Ring" lampholders has been announced. A redesigned trigger provides for selection of "Hi" while in an up position, "Lo" while in the bottom position, and "Off", while in the center position of the switch handle. Husk temperatures have been reduced from 40° to 25° F. by a ventilated lamp shell. It is insulated with G-E Mycalex. Rings on the new lampholder automatically center the lamp in the husk and in the glass bowl assembly and prevent lateral motion of the lampholder itself. General Electric Company, Bridgeport 2, Conn.

You can tell, just by looking at this ballast, that it...

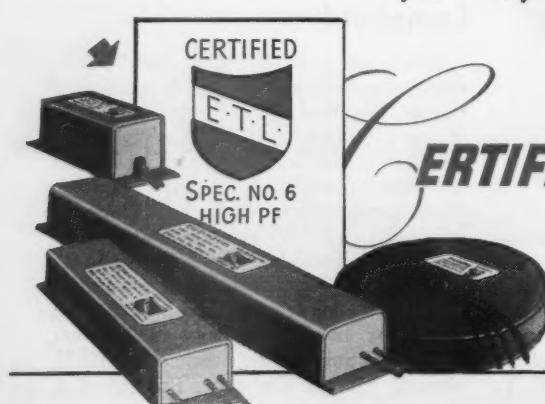


WILL GIVE MAXIMUM LAMP PERFORMANCE!
WILL OPERATE QUIETLY!
GIVES DEPENDABLE, LONG SERVICE!
WON'T OVERHEAT!

Simply insist that ballasts
you use carry the "CERTIFIED" label.
Then you're sure you'll get satisfactory
operation—that your customers will enjoy
a trouble-free, dependable product.

CERTIFIED BALLASTS are manufactured to rigid
specifications that assure you of best possible performance. They are
then tested and checked by Electrical Testing Laboratories, Inc., against these
specifications. When they pass this testing, they are CERTIFIED.

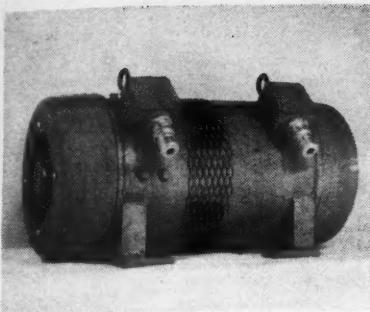
By insisting on CERTIFIED BALLASTS in the fluorescent lighting equipment
you sell, you practically eliminate customer complaints—
build better customer acceptance and goodwill.



CERTIFIED BALLAST MANUFACTURERS

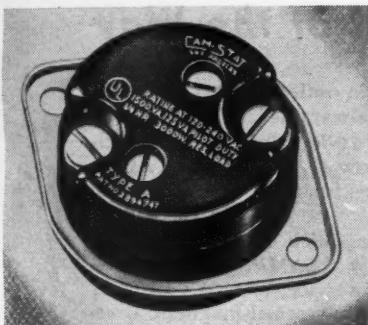
Makers of Certified Ballasts for Fluorescent Lighting

*2138 KEITH BLDG., CLEVELAND 15, OHIO



Motor Generator Set

A new high frequency motor generator set has been developed. Generator has 14 poles and when designed to run at 3440 rpm., produces 1000 volt amperes at 400 cycles. Motor has four poles. Motor and generator armature are carried on heavy shaft with dual grease sealed ball bearings on outer ends. Removable end covers make d-c brushes and collector ring brushes easily accessible. It is 23-11/16 inches long, 12-1/8 inches wide and 13-1/8 inches high. The input and output wires are enclosed in individual outlet boxes. Kato Engineering Co., Mankato, Minn.



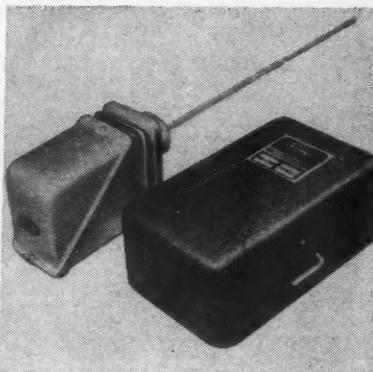
Control

A new automatic temperature control for direct line or low voltage application is now available. It is a variation of Cam-Stat's basic Type A control and is especially designed as a high limit control on unit heaters and forced air furnaces. It measures 1-9/16 in. in diameter and 1-13/32 in. in depth, permitting integral mounting. It is approved by the Underwriters' Laboratories. Features include: a current carrying capacity of 1500 volt amps. and 1/4 hp. at 115 volt a-c without the necessity of a condenser; temperature ranges adjustable from 50 to 350 degrees F or factory set to designated specifications; switching arrangements of SPST break or make on temperature rise, SPDT and independent circuit double throw. Cam-Stat, Inc., 2310 South La Cienega Blvd., Los Angeles 34, Calif.

Portable Electric Cords

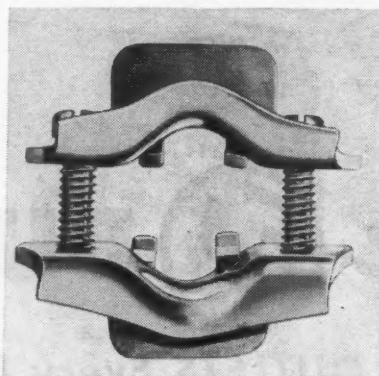
A new line of portable electrical cords featuring heavy-duty neoprene rubber jacket to provide protection against abrasion and damage, has been introduced.

Thickness of jacket has been increased 30 to 60 percent without increasing overall diameter of the cord. Laytex insulation is used on the individual conductors within the cord. They are made in sizes 10 to 18 with two, three or four conductors, with or without steel wire reinforcement. Cords are designed to withstand extreme flexing, constant movement and surface abuse. They are intended for use on tools, washing machines, portable lamps, sound equipment, refrigerators, heaters and other electrical equipment. United States Rubber Company, Rockefeller Center, New York, N. Y.



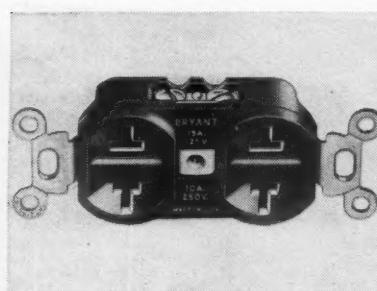
Control

Fireye flame failure safeguard is for industrial gas oven, kiln, and boiler protection. Electronic flame rod Type 45JQ1 is used with programming control Type 24PJ8 for full automatic burners. It is used with control Type 24QJ5 when only operating protection is required. Various combinations of auxiliary exhaust fan timers and relays are available to meet particular oven requirements. When flame fails, it instantly cuts off fuel and can be wired to sound an alarm automatically. Operates on 115 and 230 volts, 50/60 cycles. Combustion Control Corporation, 77 Broadway, Cambridge 42, Mass.



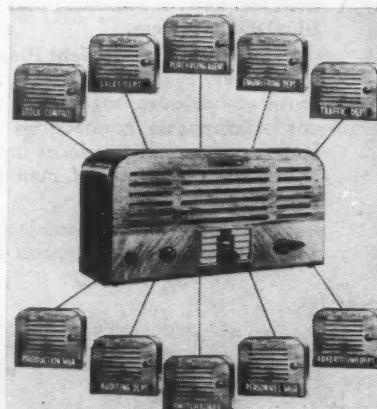
Cable Connector

The new No. 333 BX cable connector is now available. It is claimed that these connectors have simplified the installation of connectors to a one-two-three process of tipping the connector into the box, slipping the cable through, and flipping the screws tight. They allow extra working space. Connectors carry Underwriters' approval. Tomic Sales and Engineering Co., 4864 Woodward, Detroit 1, Mich.



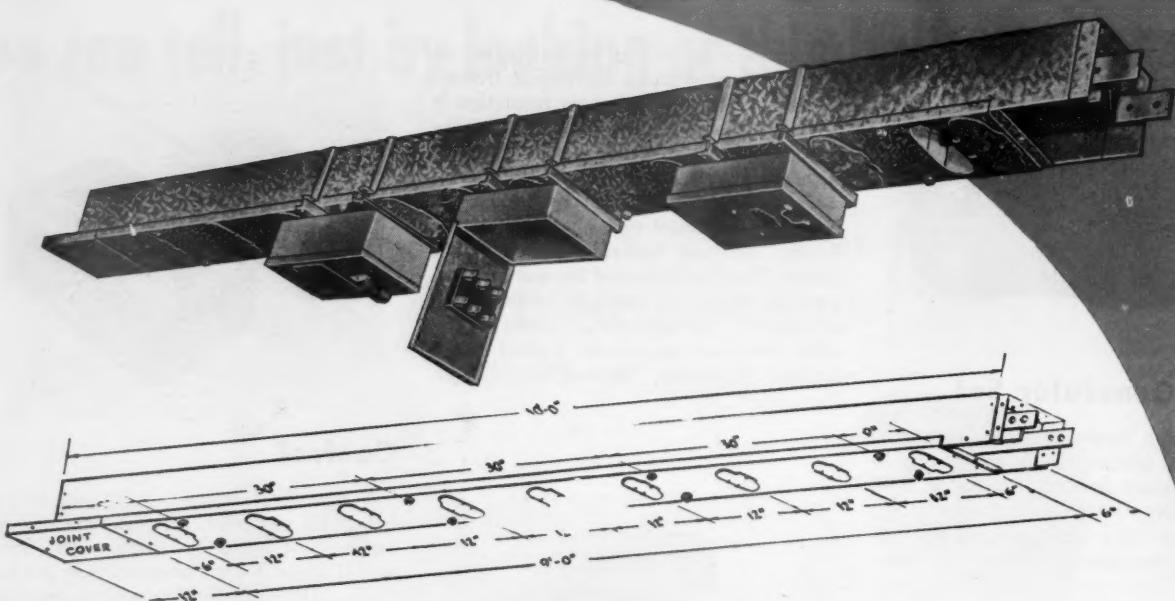
Duplex Outlet

This new No. 9260 duplex convenience outlet has a bakelite housing, built in yoke, washer type plaster ears and double sided contacts which assure proper electrical connections. It can be installed for either side or back wiring. The large head terminal screws are used in the conventional manner for side wiring. For back wiring the stripped wire is inserted from the back and gripped by individual clamps eliminating any exposed wire. The Bryant Electric Company, Bridgeport 2, Conn.



Inter-Communication System

The new Model KRUL-40 "DeLuxe" line of inter-communication systems has been announced. The system consists of one master station, which delivers a maximum of 2½ watts of "voice range" power. Basic systems, consisting of one master station and one sub-station, may be built up progressively adding substations as they are needed. Master station operates on 110-115 volts, either a-c or d-c. Extending from rear of master station is a 6 ft. flexible cable. Attached to this is a junction box which is mounted on the floor moulding. All wires from the sub-station are run into this box. They carry Underwriters approval. Talk-A-Phone Co., 1512 So. Pulaski Road, Chicago 23, Ill.



Plugin FA BUSDUCT

Provides PLUGIN OUTLETS Every Foot of the Way

More and more industrial plants are replacing their costly, complex and outmoded electrical systems with the new, economical and flexible PLUGIN  BUSDUCT system.

By providing convenient Plugin outlets every foot of the way, Plugin  Busduct makes it possible to move and relocate machinery at will... eliminates costly temporary connections and long, expensive lead-ins... greatly reduces maintenance costs... and saves thousands of man hours normally lost each year.

You'll find this economical, flexible system of power and light distribution helps speed produc-

tion by providing a Plugin outlet within convenient radius of your needs... always.

Available in standard 10-foot lengths in capacities from 250 to 1000 amps. for 575 volts AC or less, with multiple outlets for any of the following Plugin Units:

 SHUTLBRAK—for quick make and break, heavy-duty operations;  KLAMPSWITCHFUZ—splendid for disconnect service; and  CIRCUIT BREAKER—for automatic, thermal-magnetic over-load protection.

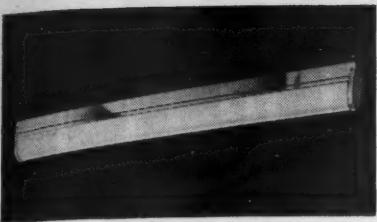
For further details, write for our new Bulletin No. 701.



Frank Adam Electric Co.

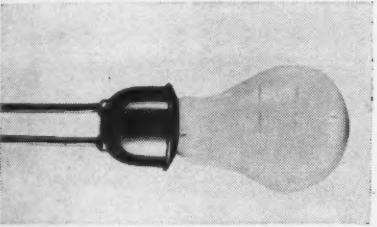
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Makers of BUSDUCT • PANELBOARDS • SWITCHBOARDS • SERVICE EQUIPMENT • SAFETY SWITCHES • LOAD CENTERS • QUIKHETER



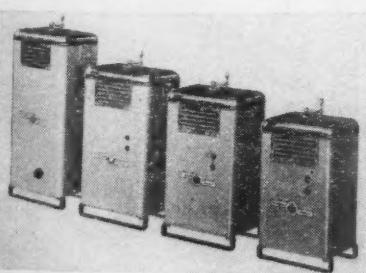
Lighting Unit

Unite-A-Lite is a movable fluorescent lighting unit which can be plugged in end to end. It may be hung anywhere, singly or in continuous line using the nearest convenient outlet. It may be moved to a new location since it has a simple mounting device and does not require a special fixed outlet or connection. Fixtures may be made any length desired. The shield is fabricated from Vinylite plastic sheet. Moe Bridges Corporation, Sheboygan, Wis.



Socket

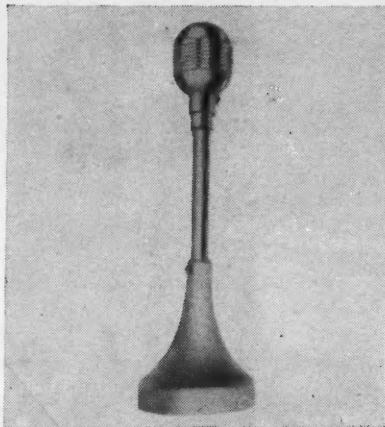
This all-purpose electric light socket is waterproof, weatherproof and vaporproof. Sealed with Neoprene that is resistant to water, oil, heat and cold. The manufacturer claims that with this sealing the Neolite may be submerged in water without fear of shock. It is recommended for outdoor decorative and utility lighting and for use wherever a lamp may be exposed to weather, oil or rough treatment. Available in any standard color. Neoline, Inc., 130 S. Hewitt St., Los Angeles 12, Calif.



Industrial Welder

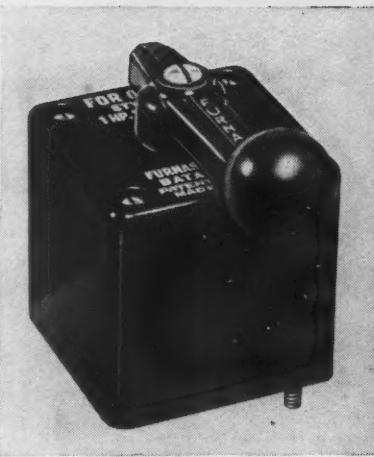
A new and smaller designed Flexarc industrial line of a-c welders is available. They are called "The 65 line" for the open circuit voltage. Built in low voltage control assures high operating efficiency in the low current range; built in capacitors assure high power factor. Natural ventilation, movable core reactor

operated by single ball crank current adjusting mechanism guarantee minimum maintenance, it is claimed. To reduce overall size, fan cooling is employed in the 500 ampere ratings. Westinghouse Electric Corp., Pittsburgh 30, Pa.



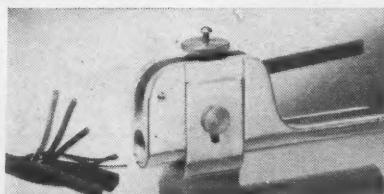
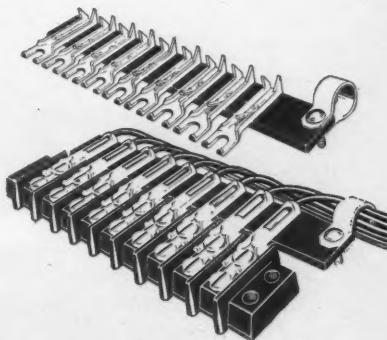
Pathway Light

The new Pathfinder light is designed for use along paths, walks, driveways, steps, platforms, in parks, on docks, porches and other places where illumination is required in moderate volume for safety and convenience. The complete assembly consists of a head or lighting unit, riser conduit and a canopy base with outlet box, having 7 inch spike. Cylindrical in shape, the three inch by three inch lighting unit consists of an aluminum cap, lens socket, and yoke section over a socket tube. Unit is furnished for low voltage or standard 100 volt circuits. Knockouts are provided in outlet box for conduit. Cannon Electric Development Company 3209 Humboldt Street, Los Angeles 31, Calif.



Motor Controller

The new "A" series 1 hp. controllers are designed for medium industrial or work shop equipment. They are available in four switching arrangements: reversing, two-speed, series-parallel and 3 pole off-on. Series has plastic case, handle and contact rotor. Several mounting arrangements are available such as an angle bracket, flange mounting plates and plates for attachment to several styles of standard outlet boxes. Rated: 1 hp. single and 3 phase 110 to 550 volt a-c; $\frac{1}{4}$ hp. 115 to 230 volt d-c. Non-inductive loads: 10 amps. 110 volt a-c, 5 amps. 220 volt a-c. Furnas Electric Company, 503 McKee Street, Batavia, Ill.



Tool

A new tool, known as rapid rubber ripper, for the opening of the outer walls of all rubber multiple conductor cords, Romex wire, lead incased wires and lead incased telephone cables has been announced. It has a sharp cutting edge, triangular in shape, and blunt point. It pushes the inside conductors far enough away to allow the cutting edge to cut or rip the outer wall without damage to the outer wall of inner conductor. Costelow Electric Co., 2757 Holmes Street, Kansas City, Mo.

Fanning Strip

With fanning strip, multiple wiring to barrier terminal strips is simplified and facilitated. From one to 20 wires from the cable lead-in can be securely anchored to proper terminals and soldered. Connections through fanning strip can be made on a bench or anywhere apart from the mounted barrier strip, and the entire assembly slipped into place in the barrier strip. Brass terminals are cadmium plated. They are riveted on a heavy bakelite mounting base. Terminals are $1\frac{1}{4}$ inches. Length of fanning strip is determined by the number of terminals used. Unit is designed for use with Jones barrier terminal strips Nos. 141 and 142. No. 141 provides for one to 20 contacts, and No. 142 one to 16 contacts. Howard B. Jones Division, Cinch Mfg. Corporation, 2460 W. George St., Chicago 18, Ill.



LIGHT
with
DISTINCTION
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Pittsburgh Permaflector Fluorescent and Incandescent Standard Units make it easy to achieve the illumination you require without costly special-made equipment.

Custom effects of infinite variety and superior performance can be easily obtained with Permaflector Planned Lighting.

Get the details now on how you can gain these more effective and efficient illuminating results by using Pittsburgh Permaflector Equipment.

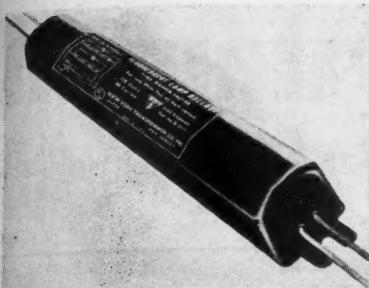
A PERMAFLECTOR PORTRAIT
Joseph Magnin—Sacramento, Calif.
Designed by: Grün & Krummeck—Associate
Luppen & Hawley—Elec. Contractors



PITTSBURGH REFLECTOR COMPANY
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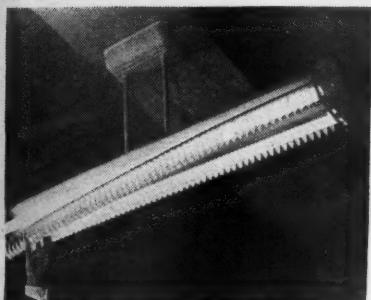
MANUFACTURERS OF FLUORESCENT AND INCANDESCENT LIGHTING EQUIPMENT
DISTRIBUTED BY BETTER ELECTRICAL WHOLESALERS EVERYWHERE

Permaflector Lighting Engineers in All Principal Cities



Lamp Ballast

A complete line of fluorescent lamp ballast units available in over 30 standard types has been introduced. Included in the standard line are many special small cross-section ballasts for streamlined housings as well as normal and high power factor types. All units are light in weight and silent in operation, it is claimed. The New York Transformer Company, Alpha, N. J.



Shield

This new riveted snap-on clip of the no-glare "Softone" shield has been announced. This new fluorescent light diffuser is made of half hard aluminum and features a new contour. Available in all lengths, for both hot and cold cathode and slimline. Spring steel clip riveted to shield. Easily installed and removed. Roc Industrial Corporation, 101 Park Avenue, New York, N. Y.

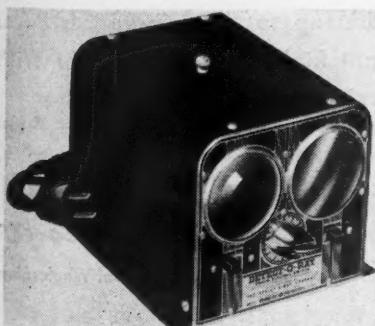
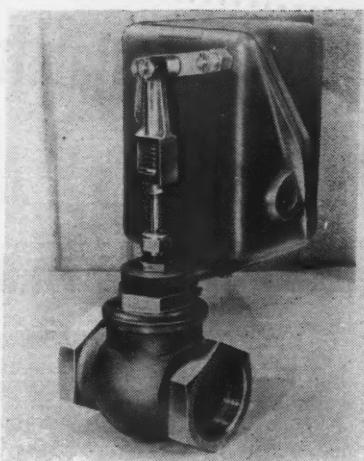


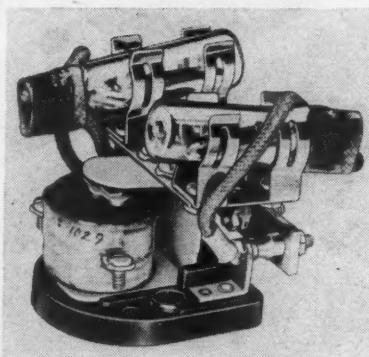
Photo-Electric Unit

An electric eye unit which can be used to "throw the switch" on door openers, automatic counters, conveyor controls,

safety shut-offs, fire warnings, burglar alarms, illumination, customer signals, drinking fountains or other applications to which a switch operating on the breaking of a light beam, visible or invisible, is suited, has been announced for use in institutions, factories, laboratories, stores, theatres, night clubs, restaurants, homes, etc. Light source, photo-electric cell, power switch, continuous or intermittent signal switch, volume control and invisible or visible beam selector are housed in a single unit. Basic unit measures 5 by 6 $\frac{1}{2}$ by 7 inches. Detect-O-Ray Company, 2622 N. Halstead St., Chicago 14, Ill.



Limit switches are adjustable and are designed for trouble free service. Cast iron housing is dusttight and splash-proof. Electrical connections are made to a terminal block; half inch threaded conduit provided. It requires a 3 wire thermostat, pressure switch or other similar instrument for actuation. Operates from either 24, 110 or 220 volts, a-c. Automatic Temperature Control Co., Inc., 34 East Logan Street, Philadelphia 44, Pa.



Relay

This new mercury contact relay is especially suited to current control in installations where there is danger of fire or explosions due to ignition of fumes, dust or gas by arcs from open switches. The unit is sealed and arcless. It is suited to motor-starting, heating unit and lighting applications in hospital operating rooms, acetylene generating plants, chemical laboratories or where there is danger of arc ignited explosions. The coil is protected against moisture and high humidity by baked varnish coating. The relay can be supplied for voltages up to 400 a-c or 230 d-c, with all contact arrangements up to double pole, double throw, normally open or normally closed. Potter & Brumfield Sales Co., 549 Washington Blvd., Chicago 6, Ill.



Magnetic Motor Control

The new magnetic Farmstarter is designed for farm applications and intended for across-the-line motor starting service. It has dual voltage coils and will serve for a 1 $\frac{1}{2}$ hp. motor when operating on 115 volt single-phase service or a 3 hp. motor on 230 volt service. Special features include: De-ion arc quencher; solid silver contacts; solderless connectors; bimetallic overload relay that requires no replacement parts to restore service after overload; and, built-in pushbutton control that simplifies wiring. Remote control is possible with a separately mounted pushbutton. Westinghouse Electric Corp., Pittsburgh 30, Pa.

New Benjamin "Series 40's"
Feature A.B.C. SIMPLICITY!



New Exclusive Benjamin "SPRINGLOX" LAMP HOLDER an advancement in Quick, Easy, SURE Lamp Insertion

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battleship construction . . . porcelain enamel's unequalled retention of the reflection factor . . . conformance to all applicable RLM, electrical and other industry specifications . . . highest quality illumination at lowest cost! All of this adds up to this assurance: "You Light Right, When You Light With Benjamin"!

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Industrial Electrification

ENGINEERING • INSTALLATION • MAINTENANCE

The Use of Capacitors in Industrial Plants—Part III

If a capacitor is considered as a kilovar generator (Fig. 1) its location becomes self-evident; capacitors should be located at or near the load area for maximum overall benefit.

It will not always be economical or practical to install capacitor units at each load, such as for every small motor. The next best practice is to install group capacitors out on the feeders serving the many small loads, as shown in C2 of Fig. 2.

Even though capacitors are installed for rate purposes only and metering is on the primary side (15 kv. and below) of the substation, it is generally more economical to install the capacitors on the 460- or 575-volt system than on the primary because of the lower cost of suitable switching devices for 460- and 575-volt service. If the utilization voltage is 230 volts instead of 460 or 575 volts, then it may be more economical to install capacitors on the primary. Such cases, however, should be individually checked.

Figs. 3, 4, 5, 6, and 7 show types of capacitor equipments commonly used in industrial plants.

Application of Capacitors for Improving the Power Factor of Induction Motors

The power factor of an induction motor at full load is quite good—between 75 and 85 percent depending upon the motor speed and type of motor. The main reason for poor power factor on such loads is motor underloading.

Capacitors have been applied to motors and switched with the motor as a unit with very good results except in a few cases. Experience has shown that when difficulties are encountered it is because too large a capacitor bank is used.

As a result of careful studies on this

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Industrial Power Division
General Electric Company
Schenectady, N. Y.

subject, Tables I and II were prepared which list the maximum recommended capacitor when the motor and capacitor are switched as a unit and connected as shown in C1 of Fig. 2. These tables also list the percent current reduction (percent AR) in the motor circuit—and, therefore, through the motor overload device—due to capacitors, which is useful in selecting the proper overload heater element to protect the motor.

As noted in these tables, the power factor at full load ranges from 95 to 98 percent, which is generally accepted as an excellent operating power factor. *The power factor at partial load, which is the usual operating condition, will be even better.* If it is necessary to improve the full load power factor above 95 to 98 percent, then the additional capacitors required must not be switched with the motor as a unit. Use a separate switching device or connect the capacitors on the line side of the motor starter.

Is it Economical to Include a Capacitor with Every Induction Motor to Improve the Power Factor?

The use of a common motor starter for switching the motor and the capacitor as a unit, as shown in C1 of Fig. 2, has become increasingly popular because it eliminates one switching device and because of the operating convenience. This unit switching arrangement is economically attractive only when a few motors are involved, or when there is no diversity among motors. For the opposite circumstance, such as is common in industrial plants with a large number of motor driven

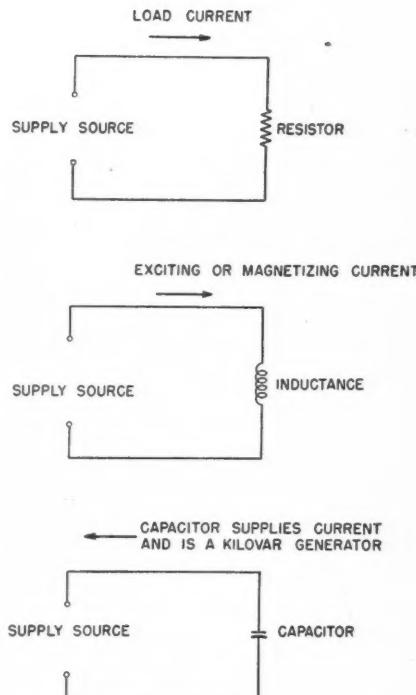


FIG. 1—Capacitor functions as a kilovar generator.

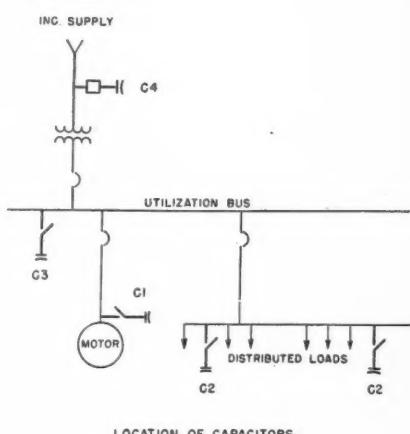


FIG. 2—Location of capacitors on industrial power systems.

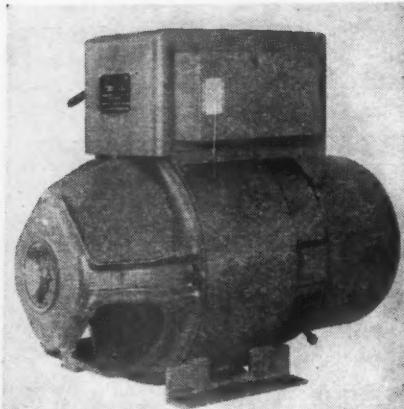


FIG. 3—Capacitor and motor starter located on welder motor-generator set for compactness and convenience. The capacitor and motor are switched as a unit and connected electrically as shown in Fig. 2.

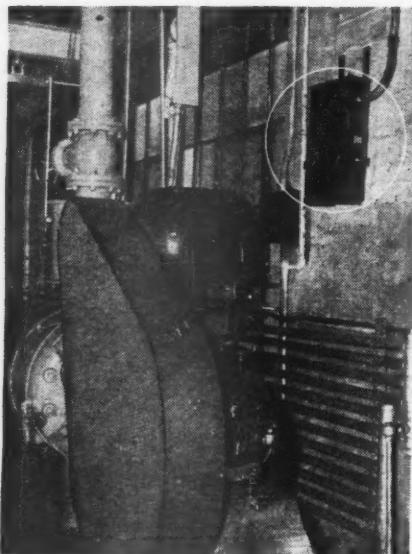


FIG. 4—Installation where the capacitor is located remote from the motor and starter but connected so that the capacitor and motor are started as a unit, as shown in C1 of Fig. 2.

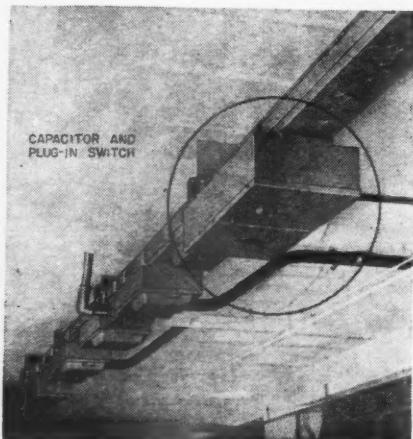


FIG. 5—Installation showing combination capacitor and plug-in switch on plug-in type feeder busway circuit. This arrangement is equivalent to C2 of Fig. 2.

equipments, improvement of power factor by the use of group capacitors, either manually or automatically switched, is usually more economical than the equivalent amount of power factor improvement accomplished by the application of capacitors to individual motors.

Fig. 8 shows the price relationship of power-factor improvement by capacitors for individual motors and the equivalent over-all improvement by group capacitors. It should be noted that the group capacitor method, with manual or automatic switching, is the most economical whenever there is any motor diversity, which is the usual case. The group capacitor method with automatic switching is practically the operating equivalent of the individual capacitor method.

In those applications involving a large number of small motors and some large motors, it is good practice to use the group capacitor method for the diversified motor load and individual capacitors for selected large motors which are in operation a large part of the time.

Cost of Induction Motor Plus Capacitors Versus Synchronous Motor

The following tables show the motor ratings where the cost of an induction motor and starter plus capacitors (including a separate switching device for the capacitors) is less than an 0.8 power factor synchronous motor and starter.

440- and 550-volt Equipment

<i>Motor Speed</i>	<i>Motor Rating</i>
<i>rpm.</i>	<i>hp.</i>
1800	150 and less
1200	100 and less
900	100 and less
600	100 and less

2300-Volt Equipment

The synchronous-motor and starter equipment cost less than the induction-motor and capacitor combination over the entire speed range if a power circuit breaker is used to switch the capacitors.

*2300-volt Motor and Control Equipment but 460- or 575-volt Capacitors**

<i>Motor Speed</i>	<i>Motor Rating</i>
<i>rpm.</i>	<i>hp.</i>
1800	175 and less
1200	125 "
900	125 "
600	125 "

* Capacitors should be located on the 460- or 575-volt systems rather than 2400- or 4160-volt systems for maximum overall benefits.

In these comparisons, the capacitor rating was selected on the basis that the induction-motor and capacitor combination will furnish the same amount of power factor improvement at full load as an 0.8 power factor synchronous motor of equal rating. At partial-load operation, the synchronous motor can supply slightly more kilovars

to the system than the induction-motor plus capacitor combination but the difference is not great enough to be the basis of the selection. Concerning losses, both methods are almost equal.

Selection of Capacitor Switching Device

In low voltage circuits, i.e., 600 volts and below, air circuit breakers or contactors are used for automatic switching, and air circuit breakers or fused safety switches for manual switching.

In medium voltage circuits, 2400 to 13,800 volts, power circuit breakers are almost always used.

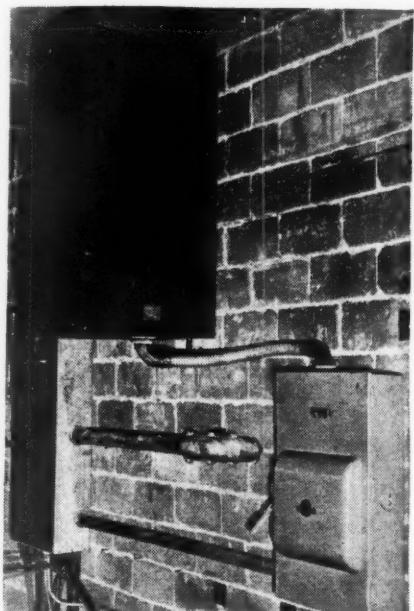


FIG. 6—Installation showing a low voltage, small rack, dusttight capacitor equipment commonly used in industrial service. Capacitors may be connected on feeder or bus as shown by C2 and C3 of Fig. 2.

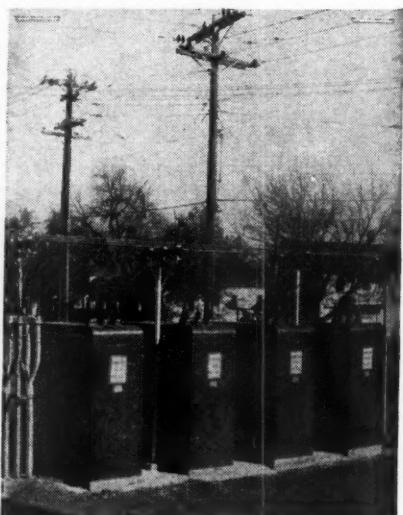


FIG. 7—Installation of 4160-volt outdoor capacitor equipment such as used in large industrial plants. Capacitors are connected to power system as shown by C4 of Fig. 2.

RECOMMENDED MAXIMUM CAPACITOR RATING WHEN CAPACITOR AND MOTOR ARE SWITCHED AS A UNIT*

TABLE I

**Normal Starting Torque Motor
Motor Speed in RPM**

In- duc- tion Motor Horse- power Rating	3600		1800		1200		900		720		600	
	Kvar	%AR#	Kvar	%AR	Kvar	%AR	Kvar	%AR	Kvar	%AR	Kvar	%AR
10	2.5	9	4	11	4	12	5	17	5	23	7.5	28
15	2.5	9	5	11	5	11	7.5	16	7.5	21	10	26
20	5	9	5	10	5	11	7.5	15	10	20	12.5	24
25	5	9	7.5	10	7.5	10	10	14	10	19	15	22
30	7.5	9	10	9	10	10	10	13	12.5	18	15	21
40	10	9	10	9	10	10	12.5	12	15	16	17.5	19
50	12.5	9	12.5	9	12.5	9	15	12	20	15	22.5	17
60	15	9	15	8	15	9	17.5	11	22.5	14	25	16
75	17.5	9	17.5	8	17.5	8	20	11	27.5	13	30	15
100	22.5	9	22.5	8	22.5	8	25	10	35	12	37.5	14
125	25	9	27.5	8	27.5	8	30	9	40	11	47.5	13
150	32.5	9	35	8	35	8	37.5	9	47.5	11	55	13
200	42.5	9	42.5	8	42.5	8	45	9	60	10	67.5	12

See footnotes bottom of Table II for explanation.

Circuit breakers, contactors, disconnecting devices (except safety switches) and all other current-carrying parts should have a current rating of at least 135 percent of the rated capacitor current. Safety switches, either fusible or non-fusible, should have a current rating of not less than 165 percent of the rated capacitor current. (From NEMA Standards for Shunt Capacitors, Publication No. 45-100.)

When contactors are used and they are housed in an enclosure, the rating should be taken as 90 percent of the open rating.

Table III lists the recommended minimum ampere rating of standard contactors, air circuit breakers, and safety switches for standard ratings of low voltage capacitors.

In high-voltage circuits, 2400 to 13,800 volts, the power circuit breaker continuous ampere rating is rarely the determining factor in the breaker selection; at these voltages the line current per kilovar is low and for the usual capacitor ratings the capacitor current is well below the breaker rating.

Automatic Control Equipment for Capacitors

The use of automatic control for switching capacitors in industrial plants is increasing. Most applications are for the reduction or control of line current or for the removal of capacitors at light load. Although many types of automatic controls are available, such as those responsive to voltage, current, kilovar, power factor, or time, the ones most common in industrial applications are:

Current—Single step

Kilovar—Generally multi-step

Voltage—Generally single step

In most industrial applications involving single-step capacitor switching, a current-responsive control usually results in better over-all operation than a voltage-responsive control because the operation of a current-responsive control is practically independent of system voltage fluctuations. If a voltage-responsive control is used, the ON and OFF settings must be wide enough to avoid unnecessary operation due to voltage fluctuations in the supply source which, therefore, nullifies the advantage of automatic switching. Also, a voltage-responsive control may switch the capacitors independent of the actual load requirements and even switch the capacitors off when they are needed most. When a current-responsive control is used, the capacitors are switched on and off in accordance with the *plant load* so the capacitors are switched off at light plant load which is desirable.

By and large, when multi-step operation is required, a kilovar-responsive control is used.

Fig. 9 shows a single step current-responsive automatic control equipment.

RECOMMENDED MAXIMUM CAPACITOR RATING WHEN CAPACITOR AND MOTOR ARE SWITCHED AS A UNIT*

TABLE II

**High Starting Torque Motor
Motor Speed in RPM**

Motor Horse-power Rating	1800		1200		900	
	Kvar	%AR#	Kvar	%AR	Kvar	%AR
5	2.5	16	3	22	4	30
7.5	3	14	4	19	5	27
10	4	13	5	17	7.5	25
15	5	12	5	15	10	22
20	5	12	7.5	14	10	19
25	7.5	12	10	13	12.5	18
30	10	12	10	13	15	17
40	12.5	11	15	12	20	17
50	15	11	17.5	12	22.5	16
60	17.5	11	20	11	25	16
75	20	11	25	11	30	15

NOTES:

*Representative data for three-phase, 60 cycle, general purpose open or splash proof type motors of 220, 440, or 2300-volt rating. For 50-cycle application the following representative data may be used:

(1) For standard 60-cycle motors operating at 50 cycles

Kvar = Kvar from Table X 1.3

Per cent AR = Same as Table X 1.1

(2) For standard 50-cycle motors operating at 50 cycles

Kvar = Kvar from Table X 1.1

Per cent AR = Same as Table.

The operating power factor, with capacitor ratings listed in these Tables, will range from 95 to 98 per cent at full load and from 95 to 100 per cent at partial loads.

#Kvar is rating of capacitors in Kilovolt-amperes.

#Per cent AR is per cent reduction in line current due to capacitors and is helpful for selecting the proper motor-overload relay when the capacitors are connected on the motor side of the starter as shown in Fig. 2.

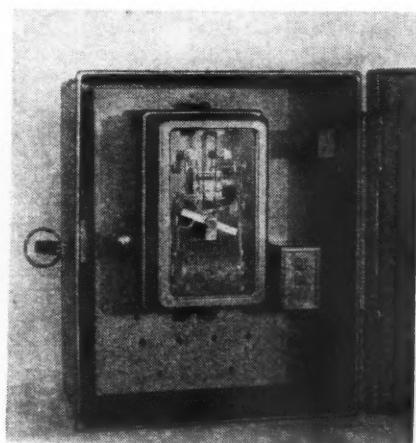


FIG. 9—Single-step, current-responsive type automatic control equipment for capacitor switching.

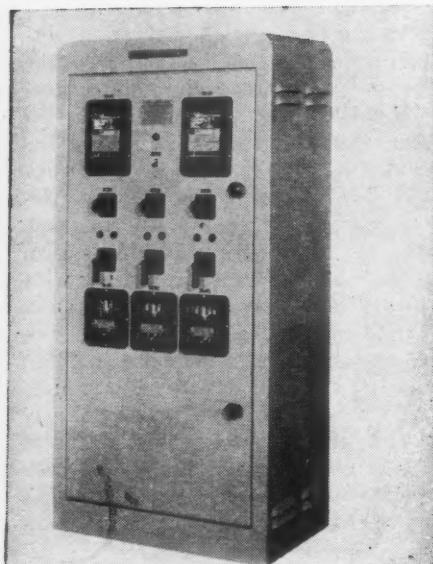


FIG. 10—Three-step, kilovar responsive type automatic control equipment for capacitor switching.

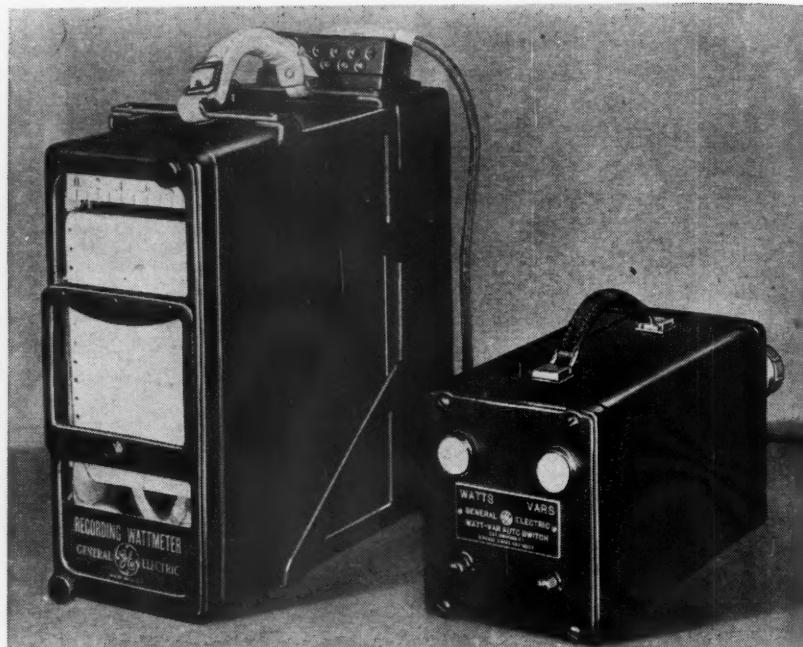


FIG. 11—New portable type inkless wattmeter and varmeter with associated equipment. (Kw. and kvar. are recorded on the same chart on a common time scale.)

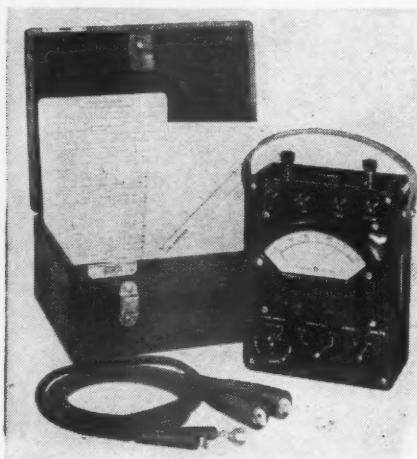


FIG. 12—Load visualizer: A compact, portable test set for determination of kw., kvar., kva. and power factor in a-c systems.

ment and Fig. 10 shows a three-step kilovar-responsive automatic control equipment.

Information Required for Power Factor Studies

When power factor studies are made it is essential that sufficient and useful data be available or taken in order to select the proper amount of capacitors. If the study is for rate purposes, then the power bills usually furnish sufficient information to do this.

Most rates, as explained in a previous section, are based on a "billing" demand which is determined from the actual demand and power factor. Actual kilowatt demand may be obtained from a demand register attachment on the watt-hour meter or by recording or printing type instruments.

Power factor may be measured di-

TABLE III

SELECTION OF CAPACITOR SWITCHING DEVICE FOR LOW VOLTAGE SERVICE

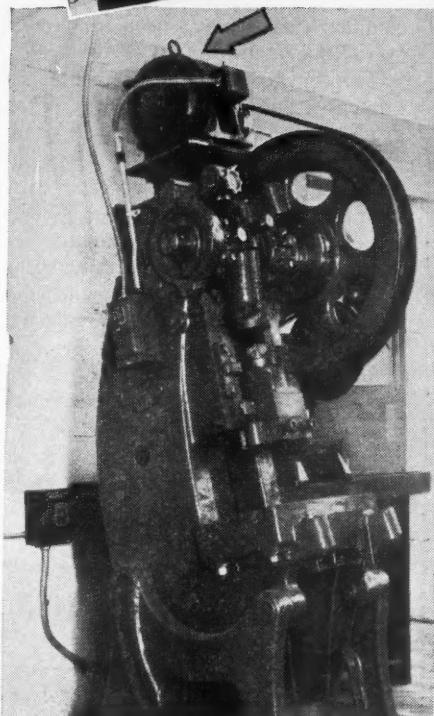
RECOMMENDED MINIMUM AMPERE RATING BREAKER TYPES (Trade Design)

Std. Capacitor Equipment Rating kvar	Enclosed Safety Switches	Open	Enclosed	AE-1-15	AE-1-25	AL-2-50 and -75
For 230-volt Capacitor Equipments						
15	100	50	100	50	50	50
30	200	100	150	100	100	100
45	200	150	300	150	150	150
60	400	300	300	200	200	200
90	400	300	600	...	300	300
180	800*	600	1200	...	600	600
270	*	900	1350	...	...	1000
450	*	2500	2500	...	...	1600
630	*	2500	2500	...	...	2500
For 460-volt Capacitor Equipments						
30	100	50	100	50	50	50
60	200	100	150	100	100	100
90	200	150	300	150	150	150
120	400	300	300	200	200	200
180	400	300	600	...	300	300
360	800*	600	1200	...	600	600
540	*	900	1350	...	...	1000
900	*	2500	2500	...	...	1600
1260	*	2500	2500	...	...	2500
For 575-volt Capacitor Equipments						
30	60	50	50	50	50	50
90	200	150	150	125	125	125
120	200	300	300	175	175	175
180	400	300	300	...	250	250
360	600	600	600	...	500	500
540	*	900	900	...	...	800
900	*	1350	1350	...	...	1200
1260	*	2500	2500	...	...	2000

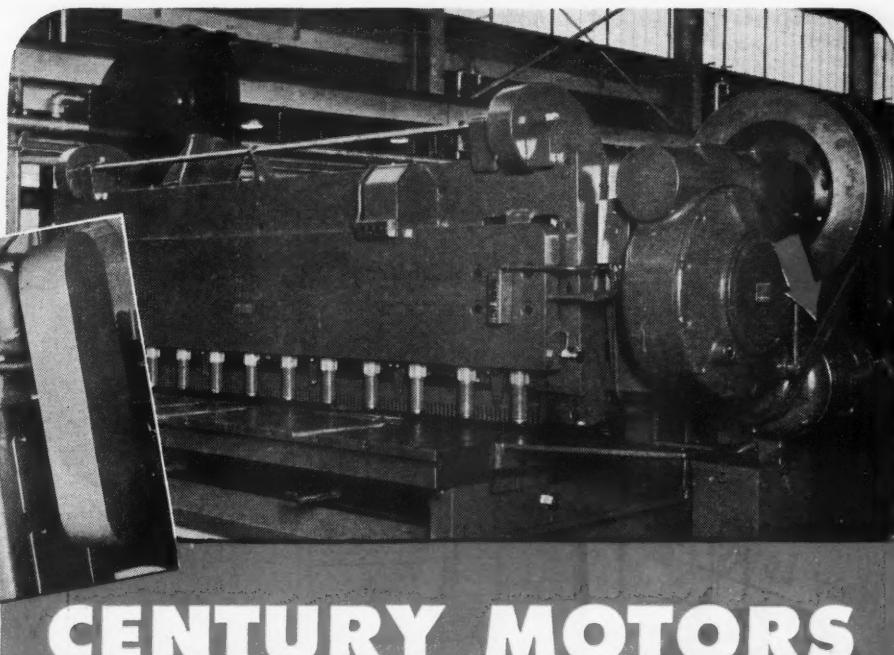
* Where switches 800 amperes or larger are required, it is usually more economical to (1) use several smaller rated equipments and switches or (2) use circuit breakers instead of large switches.

At right — Century 30 Horse Power high torque, high slip motor operating a heavy duty shear. High slip motor reduces the shock loads when shearing heavy plate.

Below — Century 20 Horse Power motor operating an automatic screw machine used for high speed quantity production.



Century 2 Horse Power, open-rated general purpose motor operating a punch press making small parts.



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Assist in maintaining close tolerance in production ...

Thousands of Century motors on machine tools in modern feeder departments are helping to maintain production schedules and keep assembly lines running. The unusual freedom from vibration of these motors assists in maintaining close tolerance in production.

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The M-2 kit box is of sheet steel, contains a variety of more than 680 fast moving parts for domestic and industrial type repulsion-start induction brush-lifting and capacitor-start motors up to and including 3 horsepower.

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Please ship Motor Parts Assortment M-1 (\$9.00 net each) \$..... Date.....

F. O. B. (Quantity) Shipping Weight 3 pounds

Point of Shipment Motor Parts Assortment M-2 (\$14.40 net each) \$.....

(Quantity) Shipping Weight 46 pounds

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Company.....

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Wagner  **Electric**

rectly or obtained from other indications such as from kw., kva., kvar. readings or from kw.-hrs. and kvar.-hrs. If power factor is measured directly, it is almost always measured at the time of average or normal conditions.

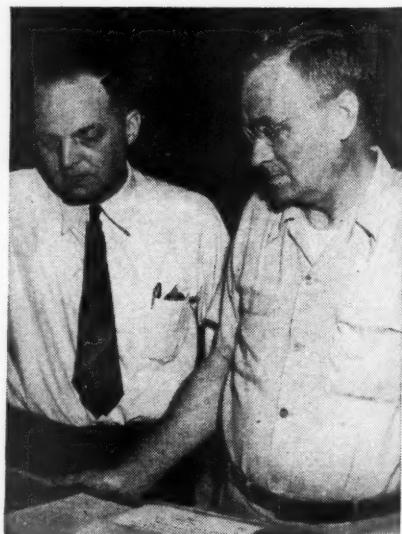
Measurements by recording or graphic instruments are most desirable and useful because they provide a permanent record. A new portable type, and very useful, instrument which records watts and vars on a common chart is shown in Fig. 11.

Indicating instruments are satisfactory for spot checking, such as for individual feeder circuits or loads. They can be used also to good advantage in place of recording instruments if readings are taken at frequent intervals.

Fig. 12 shows a new type of compact, light weight, and portable load analyzer used for quickly determining kw., kvar., kva., and power factor. A common time scale is used for recording both kw. and kvar.

The preferred measurements are kilowatts, kilovars, and volts. From these the power factor and kva. can be calculated. Voltage readings are especially desirable if automatic capacitor control with a voltage-responsive master element is contemplated.

Too often capacitors are blamed for adverse voltage conditions due to other causes. The simplest and quickest way to check on this is to read the voltage change due to switching a capacitor in and out of service, or, better yet, obtain a voltage record over a period of time, say a 24-hour period, first with the capacitors on and then with the capacitors off.



Looking over plans for a Wright Field project are E. G. Martin (left), estimator-engineer and W. M. Klinger, president, Klinger Electric Company, Dayton, Ohio. Klinger plans to develop a quick field aptitude test on his jobs to determine if electrician applicants can handle heavy construction work.

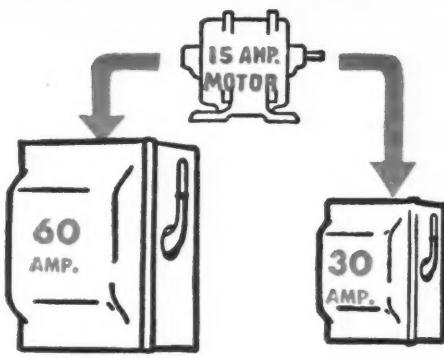
SAVE SPACE... SAVE MONEY *Get Better Protection*

On motor circuits Fusetrons can be used in sizes near to the operating load. That cannot be done with ordinary fuses. It is possible with Fusetrons because they have a tremendous time-lag that prevents them from opening on starting currents or other harmless overloads.

This means that on motor circuits, where Fusetrons are used in the same size as ordinary fuses, more motors or a larger motor can generally be used on the circuit without it being necessary to install a larger switch or panel . . . or for any given load on the circuit, Fusetrons in sizes smaller than ordinary fuses can be used.

For Example:

Take a 15 ampere AC motor on a normal installation.



OVERSIZE

With ordinary fuses, 45 amp. fuses in a 60 ampere switch must be used. The OVERSIZE fuses and switch are necessary to prevent needless blowing on the motor starting current — and you get only short-circuit protection for the circuit.

PROPER SIZE

With Fusetrons you use the PROPER size to give both motor-running and short-circuit protection — or 15 ampere Fusetrons in a 30 ampere switch.

Consider These Advantages of Fusetrons over other Protective Devices

On NEW Installations of Motor Circuits

- Save space because PROPER size Fusetrons permit using PROPER size Switches and Panelboards instead of OVERSIZE.
- More convenient location of switches and panelboards are often possible because of smaller sizes required.
- Save money on fuse replacement costs. By eliminating blowing on starting currents or other harmless overloads, fewer Fusetrons are needed than when fuses are used.

On PRESENT Motor Circuits

- Increase size of motor, or add motors to a circuit without installing a new switch or panel-board. Fusetrons permit a great increase in the actual running load on switch or panel.
- Save cost and trouble of tearing out present switch or panel by replacing fuses with Fusetrons.
- Get fuller use from every switch or panel by using Fusetrons.

Get Many Kinds of Protection Heretofore Not Available by Installing Fusetrons Throughout the Electrical System

* Entirely wipe out needless blows caused by motor starting currents or other harmless overloads. * Give Thermal Protection to Panelboards and Switches. * Prevent needless blows caused by heating in panels and switches. * Permit use of larger motor or adding more motors on circuit without installing larger switch or panel. * On new installations, proper size switches and panels can be used instead of oversize. * Protect motors against burnout. * Give double burnout protection to large motors at little or no extra cost. * Provide simplest way to stop burnouts from single phasing. * Make burnout protection of small motors simple and inexpensive. * Protect coils, transformers, solenoids against burn-out.

Get All the Facts

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Even one lost motor or one needless shutdown or one destroyed panel may cost you more than replacing every fuse with a Fusetron. Don't risk such losses, change over the whole plant to Fusetrons.

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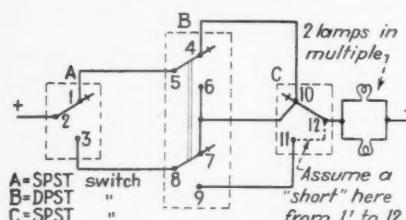
QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay \$5.00.

Reader's Quiz

Short Circuit

QUESTION 261—Two lights are connected in parallel and controlled from three points, using one four-way and two three-way switches. These had been working ok for years, but all at once these lights could be turned on from any point, but could not be shut off from the other two points. We tried this at all three switches with the same result; that is, throwing one of the switches which did not put it on, only resulted in a "flicker" of the lights. What is wrong?—R.M.

A. TO QUESTION 261—I believe the trouble may be due to a break-down in one of the three switches. RM does not give the connections, but assuming we have a diagram as shown here with the equiv-



alent of a single pole double throw switch at A and C and the equivalent of a double pole double throw switch at B, it would be possible to get conditions as described by RM if a "short" exists at 11-12. With all switches in the "up" position, the lamps can be put out by throwing switch A into the down position, that is connecting 12-11 instead of 12-10. However, if either A or B were switched from the "up" position, as shown, to the "down" position, the lights would flicker as connection 2-1 was changed to 2-3 because the circuit is momentarily interrupted as the switch is thrown, but when 2-3 was established, the lights would come on again no matter what the position of the B and C switches happened to be. I believe that a careful inspection of the three switches will show something has broken.—R.F.E.

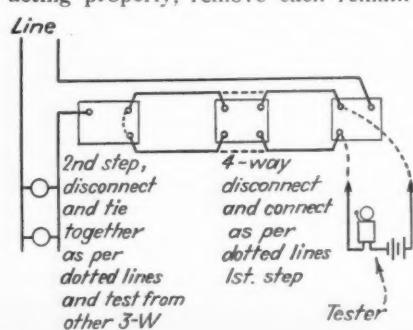
A. TO QUESTION 261—There are two troubles either of which could cause your light controlled by two three-way switches and one four-way switch to burn continuously and to flicker when either of the switches are changed to the other position.

There may be a short in either of the switches caused by a breakdown of the insulating material, or possibly one of the switches has loosened in the box and dropped, allowing the metal box to short the switch terminals.

A short in the two wires between the first three-way and the four-way, or a short in the wires between the four-way switch and the last three-way switch may be causing your trouble.

The flicker when you operate your switch shows the trouble to be in either of the described conditions, for you are breaking the circuit momentarily when the switch blades are moving from one position to the other, and your trouble would have to be either in the switches or wiring between them in order to obtain the flicker when you operate your switch.—L.O.W.

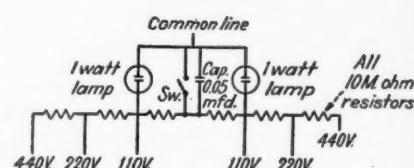
A. TO QUESTION 261—I suspect that the trouble is at the four-way switch, perhaps the blades of this switch have become bent and are making contact only occasionally. I suggest you remove the 4-way switch and connect the travellers from one 3-way to the other 3-way, after which this should work as an ordinary 3-way system and serve as the first steps in the process of elimination. If still not acting properly, remove each remain-



ing 3-way and check for warped or bent switch blades or loose connections, especially between the blades and contacts. After removing all switches, it should be a simple matter to test all wiring in the system for continuity with an ohmmeter or bell and battery set.—J.M.M.

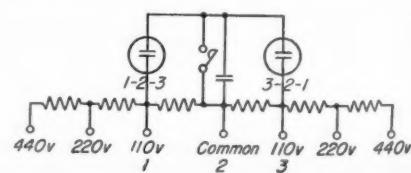
Phase Meter

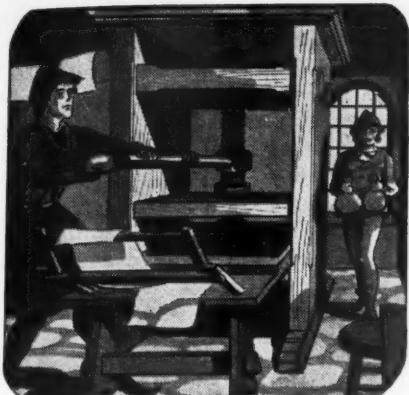
QUESTION 262—I have a home-made phase meter or phase relationship meter. If the leads are connected to the same phase every time the right hand light will glow and when the switch is closed this light will go out and



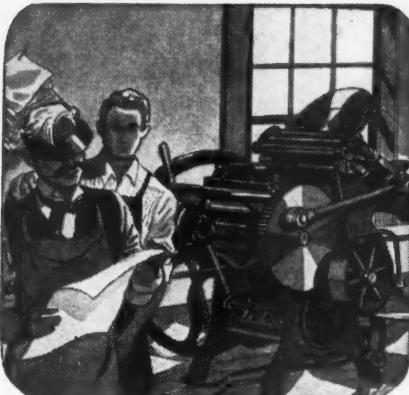
the other lamp will light according to the directions, but it fails to work properly. Can you tell me what is wrong with it? Above is a diagram of the gadget.—C.M.

A. TO QUESTION 262—I believe your diagram for a phase-sequence indicator is incorrect. The line marked "common" should be connected between the two center resistors as per sketch. Thus we have a circuit utilizing a capacitor connected in Y with two lamps to test across a 3-phase source. An unequal distribution of voltages in the Y circuit occurs, and the voltage across one lamp becomes much greater than that across the other. If the phase sequence is reversed, the other lamp will light brightly. The test switch short-circuits

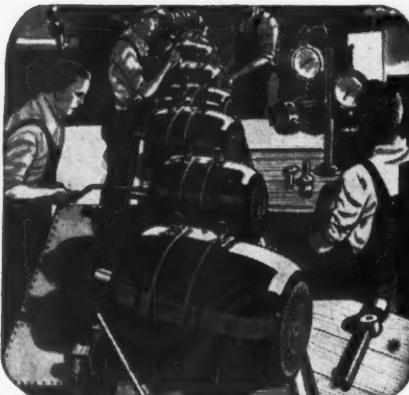




1 1450—First printing presses stemmed from cheese or cider presses. Gutenberg's hand press used type carved from wood and metal. Four centuries later printing was still largely a manual operation. But the Industrial Revolution was near.

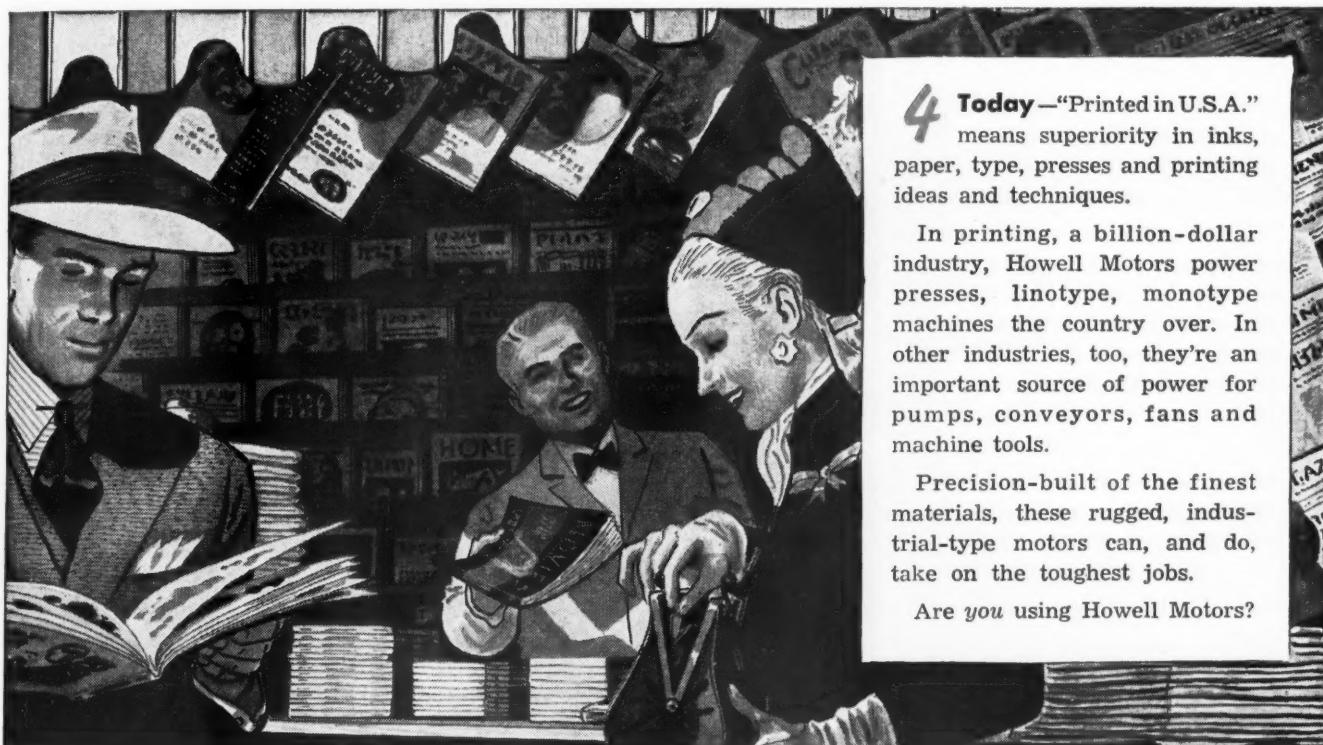


2 1875-95—Electric power revolutionized printing. Hand work gave way to powered presses and machines. Foot treadles and hand cranks disappeared. Low cost electricity started printing on its way to becoming a modern art.



3 1930—Whereas, Gutenberg was 7 years printing 200 copies of his Bible —presses of the thirties did the job in 20 minutes! In 1915 Howell "Red Band" motors were introduced. They won instant acclaim in this and other industries.

"Printed in U. S. A."—and how!



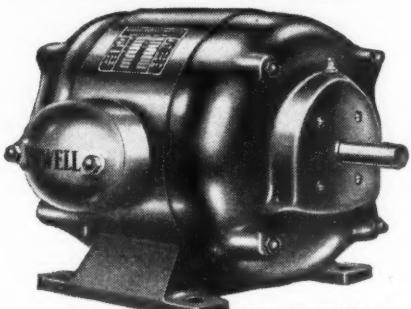
4 Today—"Printed in U.S.A." means superiority in inks, paper, type, presses and printing ideas and techniques.

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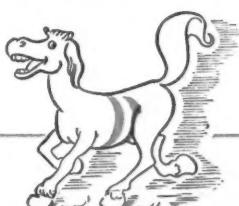


The Howell Protected Type Motors

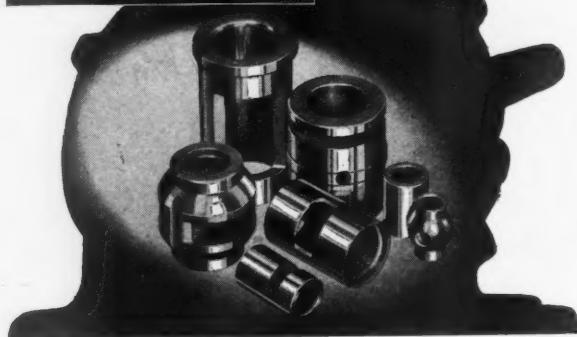
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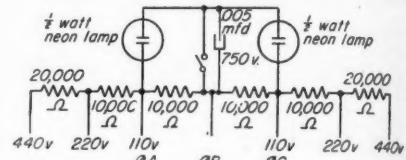
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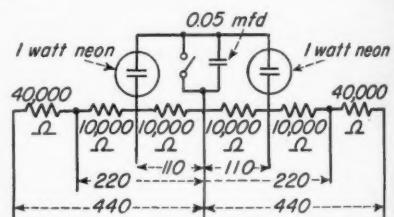
the capacitor and connects each lamp across a separate phase in which case both lamps will burn brightly indicating proper connections. The terminals must be marked and the phase sequence indicated for lighting of each bulb. If the lamp marked 1-2-3 lights brightly, the phase rotation is such that the voltage across the terminals 1 and 2 leads by 120°, the voltage across the terminals 2 and 3.—R.F.H.

A. TO QUESTION 262—The third phase is connected to the wrong side of the capacitor in C.M.'s diagram. If he will reconnect it as in the diagram below, the right hand lamp will glow if the phase rotation is



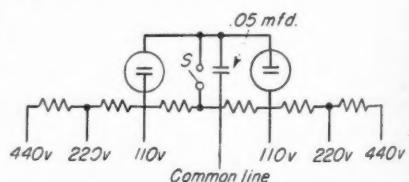
clockwise and the left hand lamp for counter clockwise rotation. If the switch is closed both lamps will glow if the indicator is working OK.—W.T.

A. TO QUESTION 262—In the diagram printed, the common line is not connected in the proper place.



The following diagram is the one I used with the following components.—B.R.

A. TO QUESTION 262—Your phase sequence meter is improperly connected. The connection marked "common line" should be made at the opposite end of the .05 mfd capacitor as shown.



The operation would be as follows. With switch closed both lamps should glow with equal brilliancy. With switch open, either the right or left lamp will glow brighter depending upon the phase sequence. If these are neon lamps and your values of resistance and capacity are correctly chosen one lamp should go out completely.—F.C.

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Changing Speed Of Motor

QUESTION 263—I would like to change the speed of a $\frac{1}{4}$ hp., 110 volt, 1750 rpm., a-c motor, to about half speed or approximately 700 to 900 rpm. Kindly show diagrams.—E.P.R.

A. TO QUESTION 263—In re-connecting a single-phase motor consequent pole to operate at half speed, the chances of satisfactory operation are almost entirely governed by the pitch of the coils. The chord factor and the distribution factor of the winding determine the new horsepower and the voltage at which it should be operated.

For instance, let us assume a four-pole-wound stator having 24 slots, wound full pitch with standard diamond coils in slots 1 and $(24/4 + 1)$ or 6 slots. If connected consequent pole, this motor would not operate because on the eight-pole connection, the magnetic and electric effects of each coil side in each individual slot would be neutralized by the other. A chocked original winding is therefore necessary for a consequent pole connection. Assuming that the distribution factor is held unchanged, this will introduce a chord factor in the calculation of the effectiveness of the windings in the two connections.

If the coil pitch of the four-pole winding is three slots or coils placed in slots 1 and 4, the chord factor will be $\sin \frac{1}{2} (3/6 \times 180) = 0.707$. In the eight-pole connection, the chord factor will be $\sin \frac{1}{2} (3/3 \times 180) = 1$. At the higher speed, the windings will therefore be $1/0.707$ or 1.41 times more effective. The winding would be appropriate for a voltage of 141 percent of the original, at the same speed. Inasmuch as the rotating field in the eight-pole connection travels half as fast, the c.e.m.f. generated with the same field strength will have half its original value. The winding will therefore be suitable for 141/2 or 70.5 volts. If connected across a 110 volt supply, this motor would be noisy and overheat in a short time. The winding of an originally parallel connected motor may naturally be made suitable for a higher voltage by connecting it in series.

If the original coil pitch were four slots or with coils placed in slots 1 and 5, the four-pole chord factor would be $\sin \frac{1}{2} (4/6 \times 180) = 0.866$. The eight-pole chord factor would be $\sin \frac{1}{2} (4/3 \times 180) = 0.866$. This result indicates that winding a coil overpitch ($\frac{1}{2} \times 4/3 \times 180 = 120$ deg.) has the same effect as winding it the

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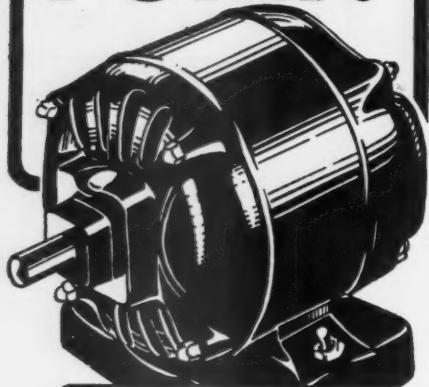
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same number of slots underpitch ($\frac{1}{2} \times 4/6 \times 180 = 60$ deg.), because the sines of 60 degrees and 120 degrees have the same sign and are numerically equal. The winding will now be just as effective in the four-pole connection as in the eight but the value of the c.e.m.f. at the lower speed is reduced to one-half its original value. If the winding were designed two-parallel at the four-pole connection, a series connection when reconnected eightpole would be suitable.

The procedure for reconnecting a concentric coil winding is practically the same as for a distributed winding. Since the current is in the same phase in all the coils, the magnetic effects of the coil sides in a pair of slots occupied by a distributed coil will be the same as if one side each of two separate concentric coils were lying in the same slots.—R.G.C.

A. TO QUESTION 263—Since the motor mentioned in this question is $\frac{1}{4}$ hp., I assume that it is single phase.

A split phase or capacitor start induction run motor cannot have its speed reduced 50% without burning out the starting winding. The centrifugal switch remains closed in starting and does not open until the speed reaches approximately 75% of the rated speed of the motor. The starting winding is not designed to remain in the circuit only during the starting period.

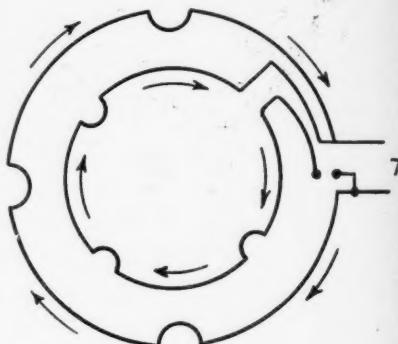
The capacitor used in the starting circuit of the capacitor start motor is not an oil filled capacitor and will not hold up for continuous operation.

A shaded pole or permanent split capacitor motor can be reduced in speed but should be connected to receive full voltage in starting. These types of motors are commonly used to operate fans when variable speed is desired in which case the hp. requirement is in proportion to the cube of the speed.

A resistance or rheostat in the cir-

cuit of a shaded pole motor is all that is required and in the case of a permanent split capacitor motor a very common controller hook-up is shown by the diagram.—B.A.S.

A. TO QUESTION 263 — If E.P.R. will connect the motor so that current will flow the same way in each of the four poles of both windings there will be induced opposite poles (without windings) between each regularly wound pole and in effect he will have an eight pole motor.



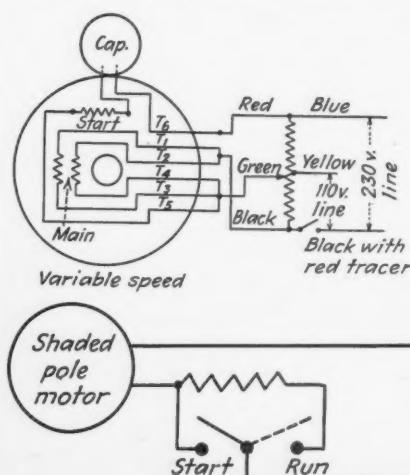
An eight pole motor will give him the desired speed, but of course the motor will have to be de-rated to $\frac{1}{2}$ or less than the original hp. rating. See diagram.—C.M.

Can you ANSWER these QUESTIONS?

QUESTION K12—We have a two light fluorescent ballast with six leads—two red and one blue from one end, one black, one white and one yellow from the other end. The connection diagram is missing, and we would like to know the internal connections of the different leads. Is there a standard color code for ballast leads applicable to all makes?—J.J.L.

QUESTION L12—When several three-phase motors are to be installed on the same branch circuit, what is an easy way of predetermining their rotation?—T.B.B.

QUESTION M12—Several times electric metallic tubing services installed according to the Code allowed rain water to escape through the main switch. It happened both before the wires were in and after the wires were in. The service head was in good shape. Why does this happen?—H.S.



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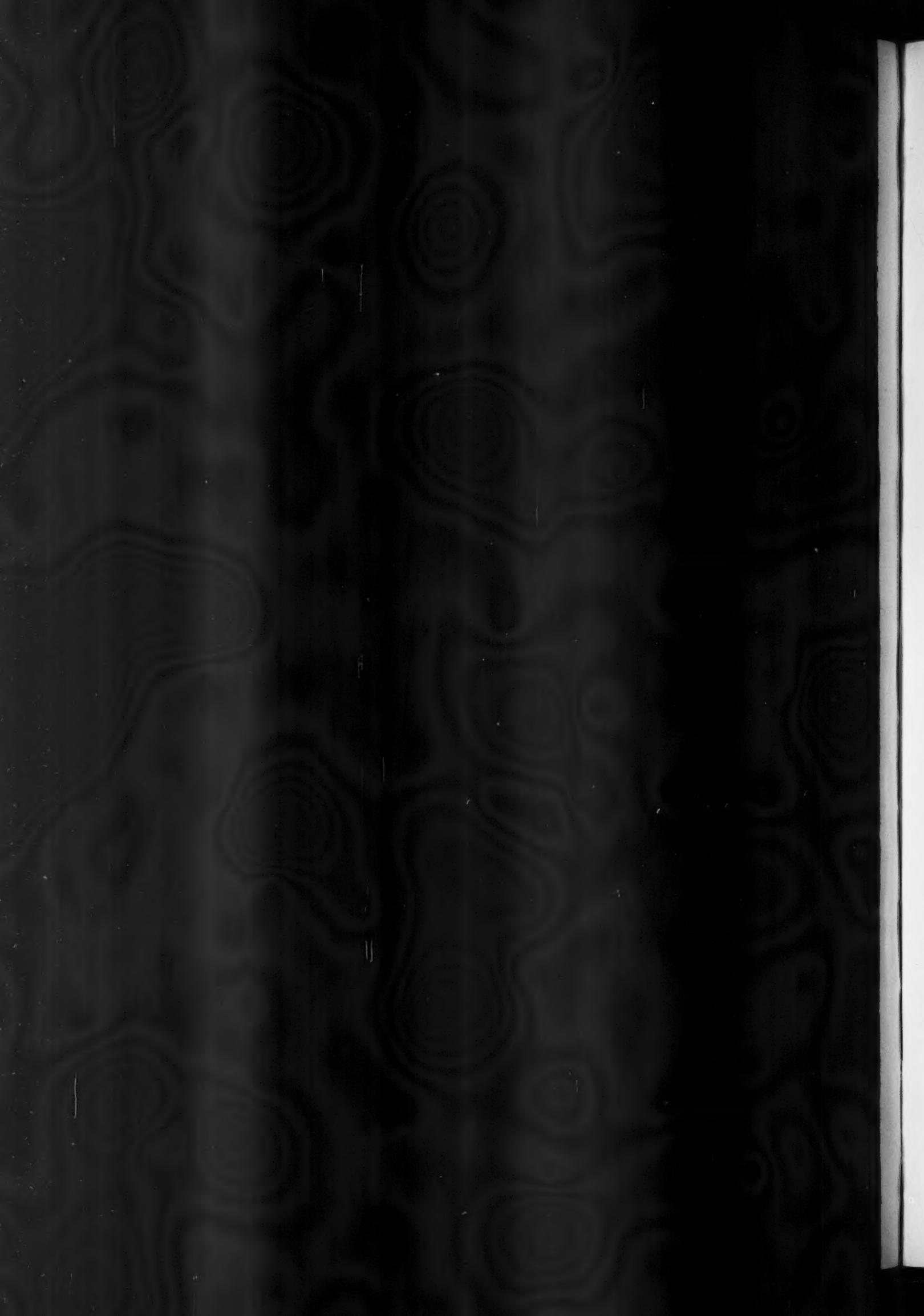
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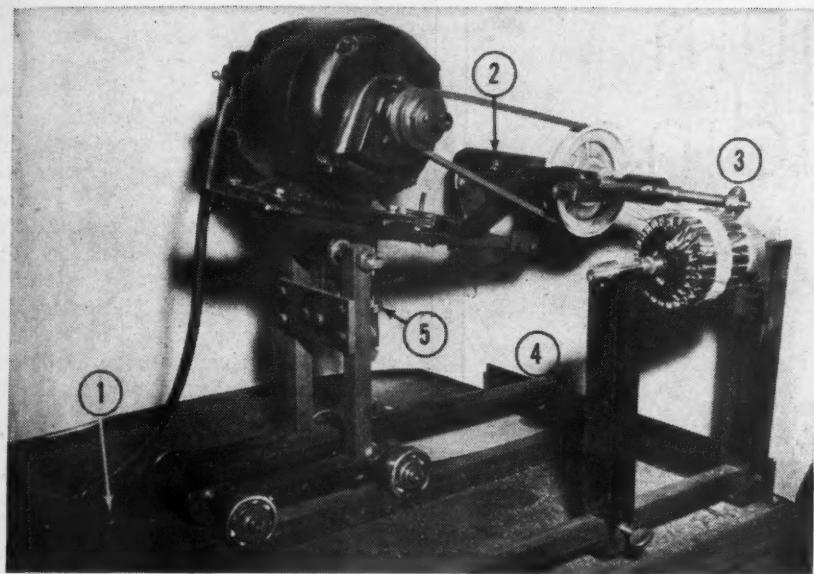
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Motor Shops



Carriage-type undercutter built at Koontz-Wagner Electric Company, rides on channel rails; has carriage stop-clamp (1) on stabilizer rail (4); operating handle (2) which houses bearing for cutting wheel shaft (3); adjustable bolt (5) controlling depth of cut; and stock of cutting wheels.

Undercutter Rides On Channel Track

Simple construction and efficient operation are features of a carriage-type undercutter developed by the Koontz-Wagner Electric Co., South Bend, Indiana. Built in the small motor repair department, it is used to undercut commutators on armatures up to 5 horsepower in size.

The actual undercutting mechanism consists of a V-belt driven shaft extension (one bearing of which comprises the operating handle) for the cutting wheel and a $\frac{1}{4}$ hp., 1800 rpm., single-phase, split-phase motor mounted to a steel plate base. This assembly pivots, 10 inches above the table top, on a sturdy steel H-frame welded to a movable carriage.

Six, 2-inch ball bearings are the carriage wheels. Four outside ones, riding in two 1-in. by $\frac{1}{2}$ -in. channel tracks, support the weight of the unit. Two center ones (one on each axle) ride in an inverted channel which holds the carriage on the tracks, prevents tipping and side-sway. Accurate undercutting is the result.

Depth of cut is controlled by an adjusting screw under the motor and pulley base. Raising or lowering this screw controls the downward pivot of the base, hence the contact point of the cutting wheel on the commutator.

A set-screw stop-clamp on the center inverted channel controls total carriage travel, hence the length of the cut. This can be set at any predetermined point for commutators of various sizes and lengths.

An assortment of cutting wheels stacked on a pin on the pivoting base provides a handy stock.

Armature supports consist of two $9\frac{3}{4}$ -inch lengths of $1\frac{1}{4}$ -in. square steel stock mounted to a square steel bar running the length of the undercutter "track". One support is stationary; the other slides along the bar and is locked into place by a thumb set-screw. Both uprights have v-slots to seat the armature shaft.

Base of the undercutting machine (channel rails, armature support bar, etc.) is $33\frac{1}{2}$ -inches long, 16-inches wide, and is bolted to the table through angle-iron end sections.

Growler Used to Expand Rings

Installing ring bearings is often difficult due to close tolerances. A simple method for temporarily increasing

bearing diameters is to heat the ring bearing for several minutes on a growler. The induced heat will expand the ring several thousandths of an inch and the bearing can be slipped into place without the necessity of using force. This method is used by the shop crew in the repair department of the J. J. Reddington Electric Service Company, Roxbury, Mass.

Locating No-Load Neutral On D-C Motors

By J. H. HOSMER
Electrical Engineer
Allis-Chalmers Mfg. Co.
Norwood, Ohio

Included in the preliminary tests made on new direct current motors or motors that have been repaired in motor service shops are: No-load brush setting, location of the no-load neutral, brush run-in, and judging of commutation.

Of the various methods used in locating the no-load neutral point, three of the most common are described below.

1. Flash Field Method

The no-load neutral is located by connecting a low reading volt-meter across two adjacent brush holders with the brushes set approximately on neutral, and then inducing into the stationary armature winding a voltage by alternately establishing and destroying a field flux (which is known as the flash field method) while at the same time observing the voltmeter indications. As the field flux decays the voltmeter will reverse its direction of indications. If the voltmeter is properly connected and noted, it will indicate the direction in which the brushes should be shifted to approach the neutral point, in case they are off neutral.

2. Voltmeter Method

In this method, the no-load neutral is determined by driving the machine up to normal speed with the field current adjusted to give normal no-load voltage across two adjacent brush holders. (Note: Machine should be separately excited to obtain close results). A brush made of fiber or other insulating material, and of the same size as the regular brushes, can be used. It must have two holes drilled

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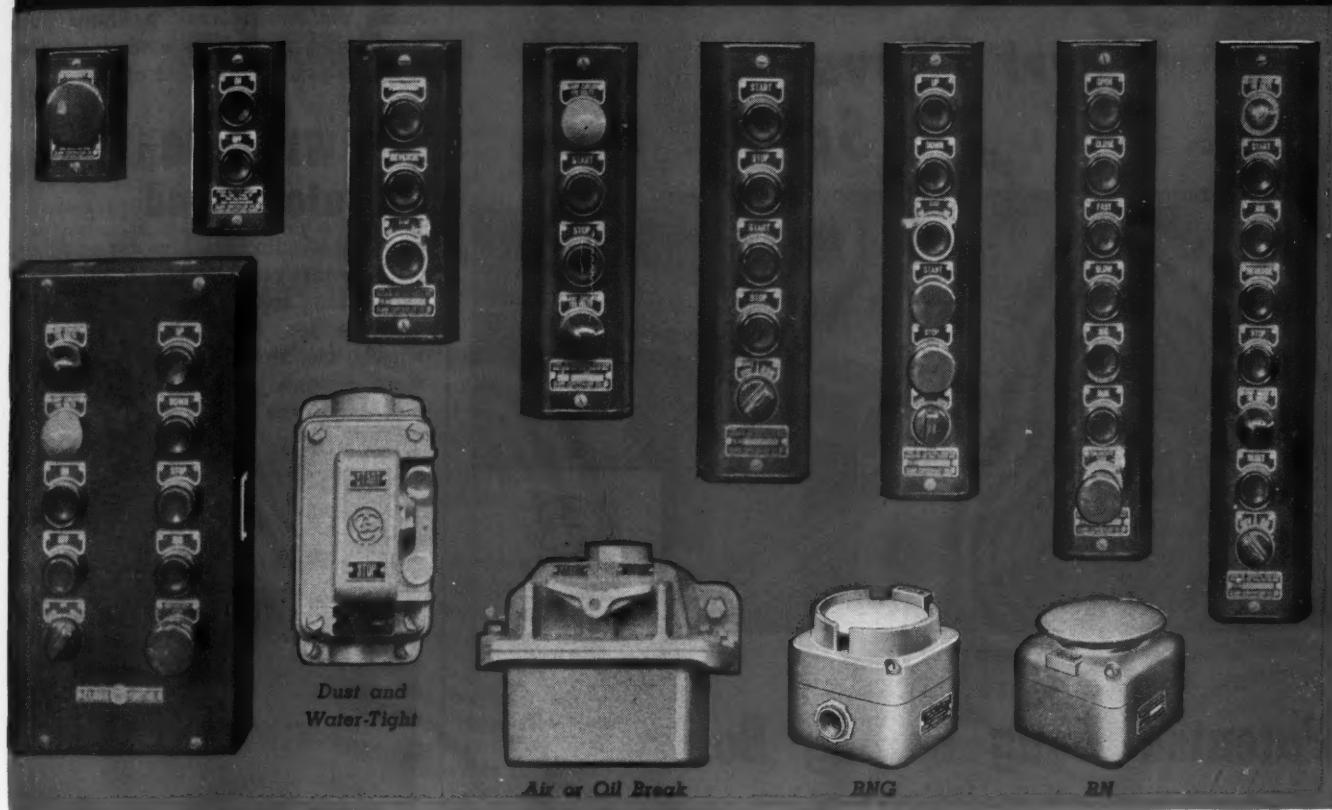
lengthwise through the insulating brush at a distance apart equal to the distance from the center of one commutator bar to the center of an adjacent bar. These holes must be large enough to allow a piece of carbon lead the size of a No. 12 bare copper wire to move freely in them, the fibre brush being inserted in place of a regular brush. The two pieces of carbon pencil lead, 5-in. or 6-in. long, are then inserted in the holes through the brushes so as to make contact on the commutator. To the free ends, the leads of a low reading voltmeter are connected. It will indicate beyond zero if the brushes are off neutral. The brushes are then shifted until the voltmeter pointer rests on zero. Marking this point, move the brushes away and note voltmeter which will indicate off zero. Then bring brushes back in opposite direction until zero is again indicated by voltmeter.

Zero torque will be generated when the brushes are located on the no-load neutral while current is passed through the armature and commutating fields of a compound interpole machine having both series and shunt fields unexcited and disconnected. Proceed in the following manner with series and shunt fields disconnected: Set brushes by inspection as near neutral point as possible, pass 75 to 100 percent current (at 10 to 15 percent voltage) through armature and commutating field coils. If brushes are sufficiently off neutral, the armature will rotate. The brushes should then be *shifted against rotation* until the armature ceases to rotate. Mark this point; then continue in the



Numbered shelves provide storage space for repair jobs awaiting delivery of replacement parts in the small motor department of the Koontz-Wagner Electric Company, South Bend, Indiana. Shelf number appears on job ticket and record for quick reference.

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Type RN and RNG, the ROUGHNECK, permits rough usage—even as a foot switch—with no damage to the Push Button Unit.



Type EE
Standard Duty

Push Button, Pilot Light and Selector Switch units are available for flush or back-of-board mounting on slate or steel panels.

For standard duty, for use with Contactors or Starters no larger than Size 4, 150 amperes, Types EE and DB are available.

Clark Push Buttons and other Electrical Control Apparatus is available through your Distributor.

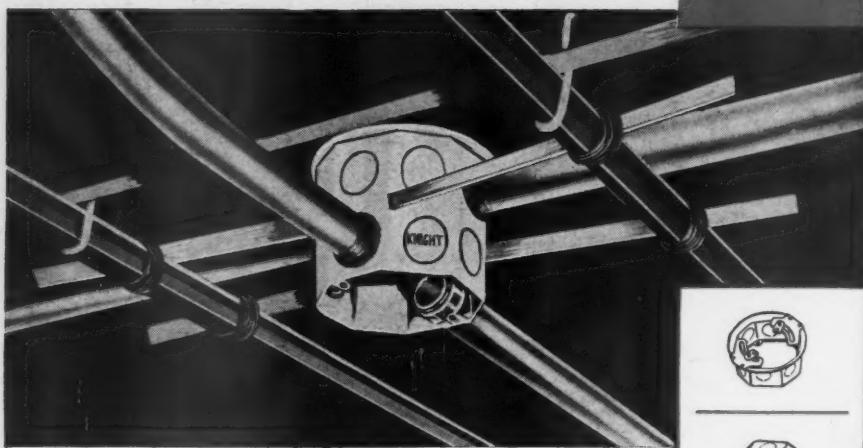


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Leading contractors have widely endorsed cost-cutting Knight Hung Ceiling Box — another exclusive Knight achievement. And it's no wonder! For this Knight box can be installed quickly and conveniently—eliminates troublesome conduit bending and special couplings. Manufactured from galvanized sheet steel, the Knight Patented Hung Ceiling Box has a permanently fastened top that cannot loosen. Thus it can sturdily withstand abuse and atmospheric action.

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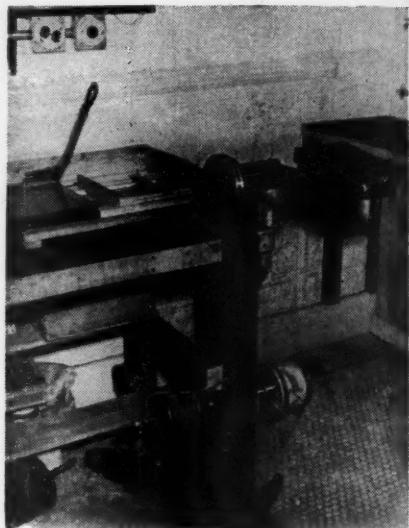
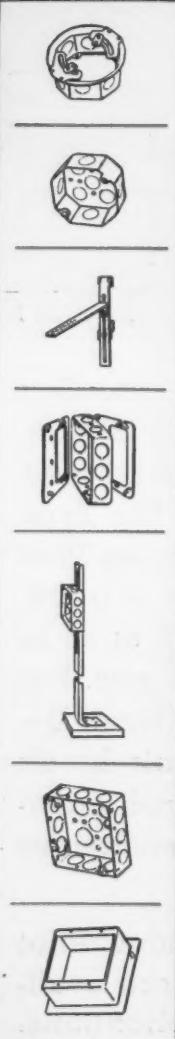
ELECTRICAL PRODUCTS CORP.

1357-63 Atlantic Ave., Brooklyn 16, N. Y.

same direction with brush shifting until the armature begins rotating in the opposite direction. At this point reverse the brush movement until armature rotation again ceases, marking this new position of the brushes. *The neutral point will be midway between the two marked positions.* A good brush fit is very essential for a true analysis of this kind of test.

Coil Winder On Vibrator Stand

A coil winding machine for winding small motors can be made from the salvaged stand and assembly used in gymnasiums for belt vibrators. Twin wheels, mounted off center, originally were designed to hold the ends of a belt and, as the wheels rotated, a recip-



Vibrating machine can be transformed into a winder for small coils by removing eccentric wheels and fitting the shaft with a circular pulley on one end and a yoke for supporting the small armature on the other. Belt drive turns pulley which revolves yoke end over end. Foot pedal controls speed of revolution through friction clutch.

rotating motion was imparted to the belt which, in turn, passed around the person undergoing treatment. In the shop of the Mo-Gen Electric Company, Stamford, Connecticut, such an assembly now winds coils.

The eccentric wheels were removed from the frame. A circular pulley was mounted on one end of the freed shaft and a yoke for holding a small armature shaft was fastened to the other end. In operation, a belt runs from a fractional horsepower motor around the circular pulley and the yoke, holding the armature being wound, revolves end over end. Speed is regulated by a foot pedal.

The assembly pictured shows the stand before the motor was connected.

G-E MERCURY LAMPS throw new light on plant profits

IN the face of rising production costs, General Electric mercury lamps offer industry a welcome money-saving opportunity. Their high efficiency makes it possible to maintain accepted lighting levels at low cost. Result: better workmanship, fewer accidents, higher morale—and more profitable operation.

G-E mercury lamps assure *lowest cost of light* for these three reasons:

- 1. HIGH EFFICIENCY**—Initial light output 40 lumens per lamp watt.
- 2. LONG LIFE**—Up to 6000 hours rated life, depending upon wattage and number of starts.
- 3. SUSTAINED LIGHT OUTPUT**—Lamps still produce 34-35 lumens per watt at 70% of rated life (burned 5 hours per start.)

These high-intensity light sources are recommended for plants with medium to high ceilings, such as foundries, assembly shops, aircraft factories. They have been used successfully for years in hundreds of plants.

No one type of lamp is the answer to every industrial lighting need. That's why General Electric makes all kinds—incandescent, fluorescent, mercury. You can count on your G-E Lamp supplier for complete, unbiased help in selecting the right lamps to meet your particular needs.



FREE BOOKLET! Call or write your nearby G-E Lamp district office for a copy of this interesting new booklet on G-E mercury lamps. Ask for Booklet F-729.

General Electric Company, Dept. E-12, Nela Park, Cleveland 12, Ohio.



G-E LAMPS

GENERAL  ELECTRIC



ILLUMINATION of 50 footcandles is maintained in this machine shop with alternate staggered 500-watt incandescent and 400-watt mercury lamps.

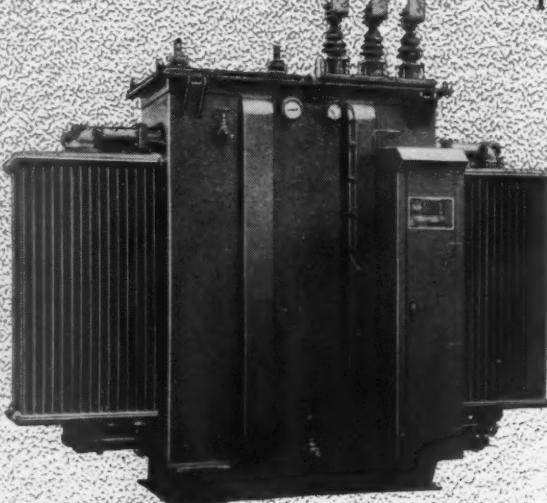
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Beneath the work bench, to which the assembly is braced, is an easily constructed holder for several reels of small-diameter wire. The holder consists of a steel rod, passing through the leg of the bench, and tipped with small steel collars containing set screws.

**Single Control
Operates Spray Booth**

The importance of safety in motor shop operation cannot be overemphasized. Volatile liquids in the form of



Pushbutton control automatically turns on lights and exhaust fan in spray booth when paint spray gun is in use. Replacing gun on lever turns off circuit.

insulating varnishes, cleaning compounds and paints are in constant use. Adequate ventilating facilities are a must item in shop design.

The management of the Koontz-Wagner Electric Company, South Bend, Indiana, leaves nothing to chance. Wherever possible, such facilities are automatically operated. Typical example is the single control that operates both the lights and exhaust fan in the paint spray booth in the small motor department.

Here, a single normally-closed pushbutton is equipped with a lever arm to operate like a limit switch. When hooked to the end of the lever, the weight of the paint spray gun lowers the arm and depresses the pushbutton which, in turn, opens the contactor controlling the fan and light circuit.

When the mechanic takes the gun off the hook, the lever rises and the pushbutton closes the circuit turning on the lights and exhaust fan.

Answered by
F. N. M. SQUIRES and **GLENN ROWELL**

New York Board of Fire Underwriters
Chief Inspector
New York, N. Y.

Electrical Engineer
Fire Underwriters Inspection Bureau
Minneapolis, Minn.

Questions on the Code

Voltage Variation on Motors

Q. Will a motor, single or three phase, which is wound to operate at 220 volts, operate successfully if it has a full load and the wiring system is changed from 115-230 volts to a network system of 116-208 volts?—G.A.W.

A. Most motor manufacturers guarantee their motors to operate successfully with a variation of 10 percent of the name plate voltage rating. That is, a motor rated at 220 volts should operate successfully from 198 to 248 volts.

Therefore a 220 volt three phase motor should be satisfactory on a three phase 120-208 volt system.

One reliable authority claims 99 percent efficiency on 208 volts.—F.N.M.S.

Industrial Wiring

Q. I have been offered the job of wiring a new sash and door factory on which no regular specifications have been prepared. This plant is located in a small suburb that does not have an electrical inspector but the owners want a safe job. Therefore I shall appreciate receiving whatever suggestions you may have to offer concerning the Code requirements for such a wiring system.—V. F.

A. The usual sash and door plant provides a most unusual wiring problem as the painting area will require some Class 1 Group D equipment, the sanding operations might create a Class 2 atmosphere, the machining of most woods brings about a Class 3 condition, and the storage and office areas are, of course, ordinary. Rooms in which paints and solvents are stored or where dipping operations are carried on must be wired as required for a

Class 1 Group Division 1 location. Areas in which sanding is done or where certain non-resinous woods, such as mahogany, are machined may be considered as a Class 2 location unless a proper dust collection system keeps the dust from being thrown into suspension in the air. Then you will find in the fine print note under Section 5006a of the National Electrical Code the statement that woodworking plants will have areas which may be considered as Class 3. This is especially true about woodworking machines where it is found difficult to prevent sawdust or fine wood chips from blanketing motors and their controllers. The refuse vaults must always be considered as Class 2 locations unless no sanding operations or work with non-resinous woods will be done.—G. R.

Stapling Cables

Q. The Inspector in this area has notified us to discontinue the use of staples on non-metallic cable. What section of the Code does this violate?

If, by chance the staples are not approved by the Department, how then can one use entrance clips, pipe straps, etc., which are also not approved by the Department?—C.V.B.

A. In all probability the Inspector has found that the last clause of the first sentence of Section 3363 has been violated. An extra blow or two of a hammer on a staple will tend to injure the cable, especially of some of the types of non-metallic sheathed cable on the market today. Of course all of the same as above might be said of armored cable also.

However, there are some pipe straps listed by Underwriters' Laboratories, so we can get some approved ones.

Many Inspection Bureaus are permitting staples where they are used with the proper care.—F.N.M.S.

Conduit Fill

Q. Does conduit fill still apply for old and new work with the new Code as follows:

60% fill for one conductor
40% fill for two conductors
50% fill for three or more conductors

such as installing three circuits in one conduit, 3 wire three phase each, making a total of nine wires in one conduit.—T.M.

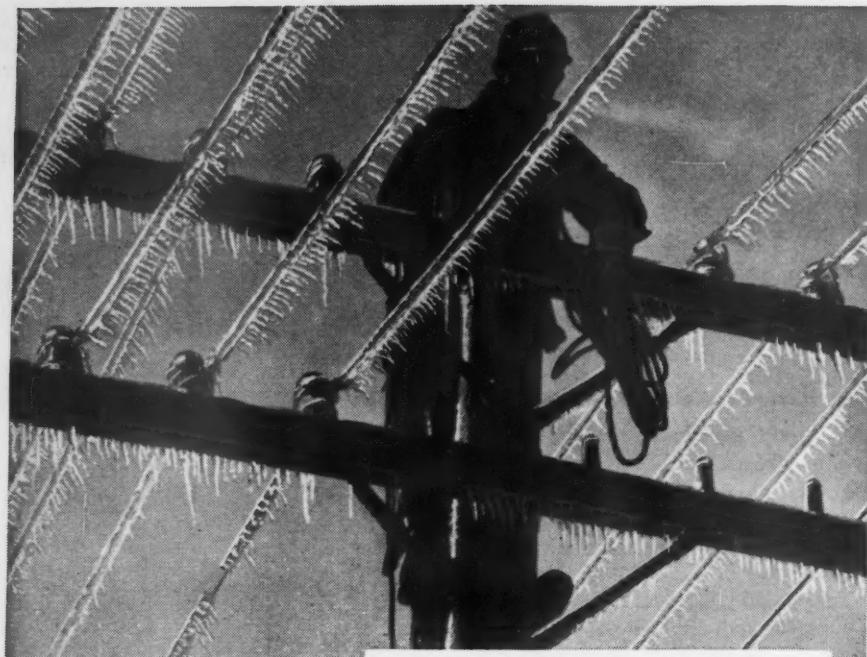
A. The percentages for conduit fill given above are not the correct ones for new work and are not to be used on old work except under very special conditions. The percentages to be used are found in Table 11 and are:

53% fill for one conductor
30% fill for two conductors
43% for three conductors
40% for four or more conductors.

The higher percentages are to be used only where an existing conduit is imbedded in concrete, making it impossible to remove it and then put in a larger conduit due to structural conditions but where increased load requires additional capacity. If a conduit is exposed this does not apply, inasmuch as in this case, it would be easy enough to install a larger conduit.—F.N.M.S.

Feeder Circuit

Q. We have run feeders to a large sign on the roof of a building using rigid conduit and type T wire. Now we understand that this should have been lead covered wire in that section of conduit exposed to the weather. Is this a local rule or does the Code require the lead covered wire?—R. M.



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A. No, the Code does not make the use of lead covered conductors mandatory. You will find that Section 6021c of the Code states "Conductors in rigid conduit, electrical metallic tubing, flexible metal conduit, armored cable or metal troughing exposed to the weather, shall be of the lead-covered type or other type especially approved for the conditions, except where rigid conduit, electrical metallic tubing or enclosures are made rain tight and arranged to drain." Therefore if the conduit run containing the feeder circuit is rain tight and is provided with a drain at its lowest point, the Code will permit the use of Type R conductors. If the drain cannot be provided or if the raceway is not rain tight, then you must replace the Type R conductors with Type RW, TW or lead covered.—G. R.

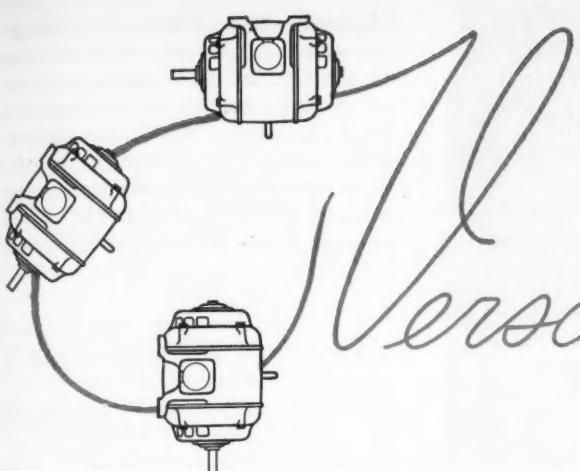
Residential Wiring

Q. I have been offered the job of wiring a number of poured concrete houses constructed of double concrete walls having an air space between the inner and outer wall. Two by two wooden strips were inserted in the forms to form channels between the light outlets. The inside finish will be plaster. Can I place Romex wire in these chases?—S. L.

A. No, unless the chases are covered to keep the plaster finish from filling the chase. Under Section 3362 you will note that nonmetallic sheathed cable may be run or fished in the air voids of concrete masonry block or tile walls where such walls are not subject to excessive moisture or dampness. However, it cannot be embedded in masonry, concrete, fill or plaster, nor run in a shallow chase in such walls and covered with plaster or similar finish. Therefore if the chases can be kept free of plaster and if the inside wall will be a dry wall, the Code will not prohibit the use of the cable as long as the channels or chases are not reduced in size to where they might be considered as a shallow chase.—G. R.

Service Entrance

Q. Section 2331 permits "service conductors entering buildings" to be "separate conductors or in cable (approved) or conduit". Please clarify the fine print recom-



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The frame can be reversed to put the conduit box on either side.

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Simple design, meaning fewer parts to wear—fewer places for trouble.

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An astronomic dial is available for dusk-dawn schedules—particularly popular for illumination of signs, billboards, and street lights. An omitting device can be furnished for omitting operation on any desired days of the week. For further information, call your nearest G-E apparatus office, distributor, or agency, or write for Bulletin GEA-3339. Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

GENERAL  **ELECTRIC**

mendation. Does it apply to conductors in conduit as well as separate conductors? I can find no limitations for service entrance conduit in wall spaces of wood buildings. Would this prevent flush mounting of service breaker? I have read 2372-2434 with its four exceptions 2305-2351-2371 and 2372. Only voltages under 600 volts are involved.—C.H.A.

A. The fine print note following Section 2331 indicates that unprotected (unfused) service entrance conductors are not to be run laterally nor vertically within the walls of frame buildings. While this note is a recommendation, most inspection authorities make it a mandatory prohibition.

Of course the service wires must be permitted to run straight through the walls in order to get into the building but should not be run around within the hollow space within the wall. The idea is that the Code has to take chances with a few inches or about a foot of these wires which are without over-current protection, but does not want to assume greater risks with greater lengths of the unprotected wires in case of short circuits.

As for the flush mounting of service circuit breakers, that would depend on the conditions encountered.

If the service wires could enter the breaker enclosure directly with only a few inches of wire within the wall, there would probably be no objections but there certainly would be objections if a few (or more) feet of wires were run around within the studding spaces.

The above applies whether the wires are in conduit, cable, or open. Open wires must enter through tubes or bushings as required by Section 2335.—F. N. M. S.

Branch Lighting Circuit

Q. The Code used to make it necessary to limit the load on branch lighting circuits in store buildings or any other similar property where the lights might all be on for long periods of time to 80 percent of their rated capacity. Now this provision seems to be removed from the Code, at least I cannot find it. Can you explain the reasons for this?—M. T.

A. The limitation on loading of branch circuits used for the lighting of stores or similar loads will now be found under Section 2116. The requirement is still the same; however, the wording has been changed as follows: "Where in normal operation the

maximum load of a branch circuit will continue for long periods of time, such as store lighting and similar loads, the minimum unit loads specified in this section shall be increased by 25 percent in order that the wiring system may have sufficient branch circuit and feeder capacity to assure safe operation."—G. R.

Bathroom Heater

Q. I have just been advised by a new electrical inspector that I cannot connect a 1320 watt built-in electrical bathroom heater to the same circuit which supplies the bathroom light outlets. This has always been common practice as the Code has permitted an appliance to be connected to a 15 ampere lighting circuit provided its rating did not exceed 80 percent of the rating of the circuit. Has this rule been changed?—F. W.

A. No, this is not a new ruling. Section 2126 of the N. E. Code limits a fixed appliance connected to a 15 ampere lighting circuit to 6 amperes or 660 watts. Only a portable appliance of not more than 1320 watts rating may be supplied by such a circuit. This same ruling can be found under Section 2125c of the 1940 edition of the Code. —G. R.

Switch Rating

Q. I recently installed a 5 horsepower 230 volt single phase motor and a controller which bore the label of the Underwriters and was rated at 5 horsepower, but the inspector refused to O.K. the job until the controller was replaced as he claimed it was only a 30 ampere switch and was not capable of controlling a 5 horsepower motor. Would any company stamp a switch as a 5 hp. switch if it could not safely operate at such a rating?—B. J.

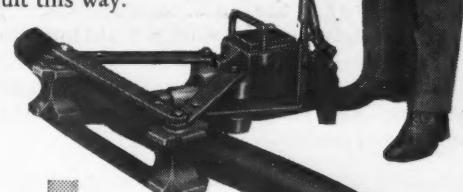
A. Undoubtedly you have reference to an enclosed switch which has a 5 hp. rating for use with d-c motors. If the name plate on the switch does not indicate that the 5 hp. rating is for direct current only, please furnish me with the catalog number and manufacturer's name. Usually a switch of this type also bears the rating of 2 hp. for use with alternating current motors.—G. R.

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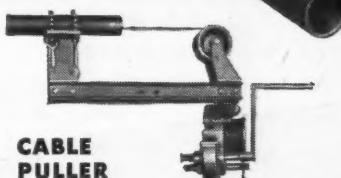
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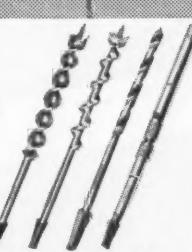
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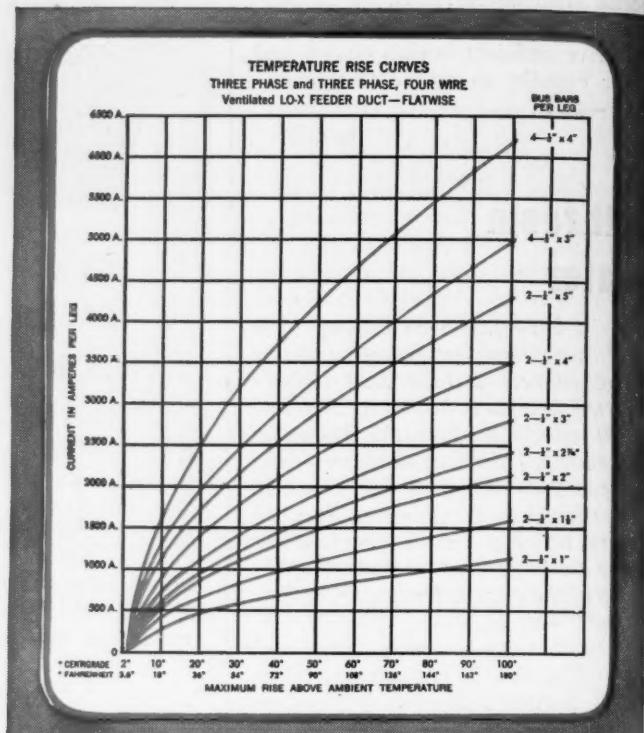


Chart shown is typical of the data on voltage drop and temperature rise available in advance of installation for all types of BullDog BUStribution DUCT. BullDog field engineers have this information at hand to help you in planning your electrical distribution system. Call the one nearest you today.



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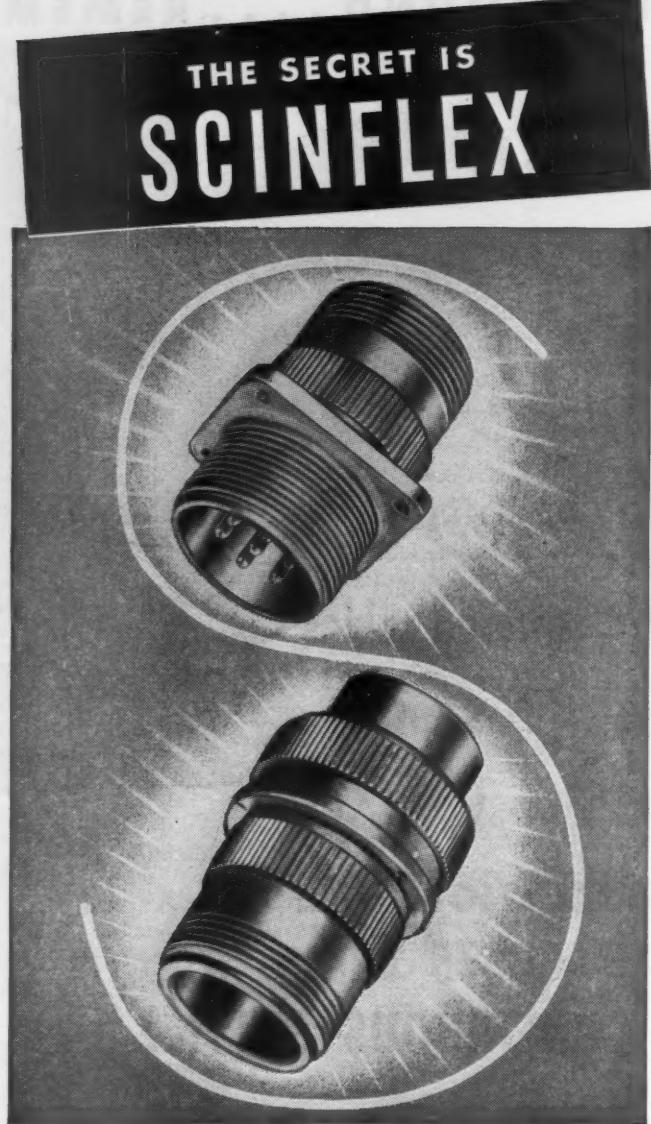
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(32) ELECTRIC PLANTS—Fully illustrated 16-page catalog in three colors gives information in plant selection to potential users of electric generating plants ranging from 350 to 35,000 watts a-c. D. W. Onan and Sons, Inc.

(33) FLUORESCENT SHIELDS—Specifications and illustrations of light shields and diffusers for slimline, cold cathode and standard hot cathode fluorescent lamps. The ROC Industrial Corp.

(34) VARNISHES — Ready-reference wall chart for quick selection of varnishes lists essential physical, chemical and electrical data and gives baking time, dielectric strengths, recommended solvents and various resistances for both Harvel and Irvington products. Irvington Varnish and Insulator Co.

(35) CONNECTOR—Bulletin 201 describes and illustrates industrial rubber-clad electrical connector for portable, mobile or stationary machinery. W. S. Hill Co.

(36) FLUORESCENT BALLASTS—Catalog contains 62 fluorescent ballasts to operate on 50 or 60 cycle, 118, 208, 220 or 236 volts. General Transformer Corp.

(37) WELDING NICKEL ALLOYS—Materials required for the metal arc, oxy-acetylene and submerged melt welding of nickel and the high nickel alloys are listed in 16-page booklet. International Nickel Co., Inc.

(38) ELECTROSTATIC PAINTING—Electrostatic painting methods for reducing amounts of paint and labor up to 60 percent are discussed in 16-page book showing illustrations of typical spray installations and explaining principles of spray painting by this method. Harper J. Ransburg Co.

(39) SPOT LIGHT — Portable rechargeable electric hand lamp with 6-volt 20-ampere storage battery equipped with built-in specific gravity indicators for use by electricians and maintenance men is presented on file-size sheet. U-C Lite Manufacturing Co.



ONE of the

great advantages of Wiremold is that there

are ten complete and interconnectable sizes of raceways and fittings, together with many special applications for lighting, power, and communications service . . . each of them just as applicable to the small job as to the large installation . . . just as adaptable to complicated layouts as to the simple extension run of a few feet.

Whether for a hospital nurse's call installation . . . for a soldering iron outlet on an assembly bench . . . or for a series of outlets on a test rack . . . you'll find exactly the fittings you need in the Wiremold Wiring Guide. Yet a minimum number of these fittings takes care of *all* requirements.

On the job, wiremen require no special tools to handle Wiremold . . . only a hacksaw, a screw driver and a pair of pliers. Nothing could be easier and faster than Wiremold installation. That's why we say, use it for **ALL** jobs . . . make the most of your time and skill with Wiremold. Write us for literature if you are not already on our mailing list.

THE WIREMOLD COMPANY

HARTFORD 10, CONN.

Sold through **ELECTRICAL WHOLESALERS** and
INSTALLED by **ELECTRICAL CONTRACTORS** Everywhere



MOTOR MAINTENANCE (FROM PAGE 65)

"MEGGER"*
INSULATION TESTER



IT'S VERSATILE—Used for detecting and diagnosing trouble in nearly all types of electrical equipment including: motors, generators, transformers, switchboards, appliances, lighting circuits, meters and relays . . . practically *everything* electrical.



IT'S EASY TO OPERATE—Simply make connections, turn the crank and take a direct reading. It's as simple to read as a voltmeter. Ratings up to 50 megohms, 500 volts.



IT'S CONVENIENT—Requires no external power supply, no adjustments, no batteries or replacement parts. DC test current is supplied by a self-contained hand-operated generator—an unfailing source, *always* ready for use.



IT'S INSURANCE—Insulation testing with a "Megger" Tester is your first line of defense in electrical preventative maintenance . . . your protection against moisture and other enemies of electrical insulation . . . a *must* in your struggle for uninterrupted electrical service.

* Trademark Reg. U. S. Pat. Off.

READ THIS BULLETIN . . . Here's the ABC of the Midget "Megger" Insulation Tester, telling briefly and in common sense language just what the Midget "Megger" Tester is, how it is used . . . AND . . . what it will do for you. Write for your copy of Bulletin 1785-EC today.



JAMES G. BIDDLE CO.

ELECTRICAL & SCIENTIFIC INSTRUMENTS
1316 ARCH STREET • PHILADELPHIA 7, PENNA.

versatile dynamic balancing machines for rotating parts.

The preparation and submission of a contract follows an established procedure. When a customer expresses his interest in a maintenance contract, an examiner is sent to the customer's plant or building and notes the type and condition of the equipment under consideration. He also checks the operating conditions, the general cleanliness of the plant, the severity of service existing and any other factors which would affect the wear and adjustment of the equipment. If major repairs are necessary, an estimate for these repairs is immediately prepared and submitted to the customer so that the equipment will be in reasonably good condition when the contract becomes effective. A maintenance contract is prepared at the same time and submitted for approval. No charges are made for these preliminary inspections and estimates. After the contract is signed, cards are prepared listing the equipment covered and the type of service contracted for. Duplicate cards are prepared for the day office, night office and district inspector-mechanic.

A maintenance program has several definite advantages. A plant is aided in giving continued service with dependable production schedules and prompt delivery of goods. Equipment is operated at maximum efficiency, giving the best possible operating results. Kept in the best operating condition, equipment is run economically. Shutdowns are reduced to a minimum, conserving the time of employees in addition to maintaining service and production. Repairs and replacements can be budgeted as a fixed monthly sum. With inspector-mechanics in the area, emergency service can be rendered in the shortest possible time. The life of both electrical and mechanical equipment is increased. Plant managers are relieved of operational worry and can devote their entire attention to their particular business problems.

Public relations and business contacts are established and maintained by a force of sales engineers. Another source of contact is our interest in and attendance at national and local technical and trade group meetings. Our four page bulletin, containing helpful hints for plant operators and titled "The Maintenance News", is sent regularly to a mailing list of 8000 in the New York City area.

Modern Lighting

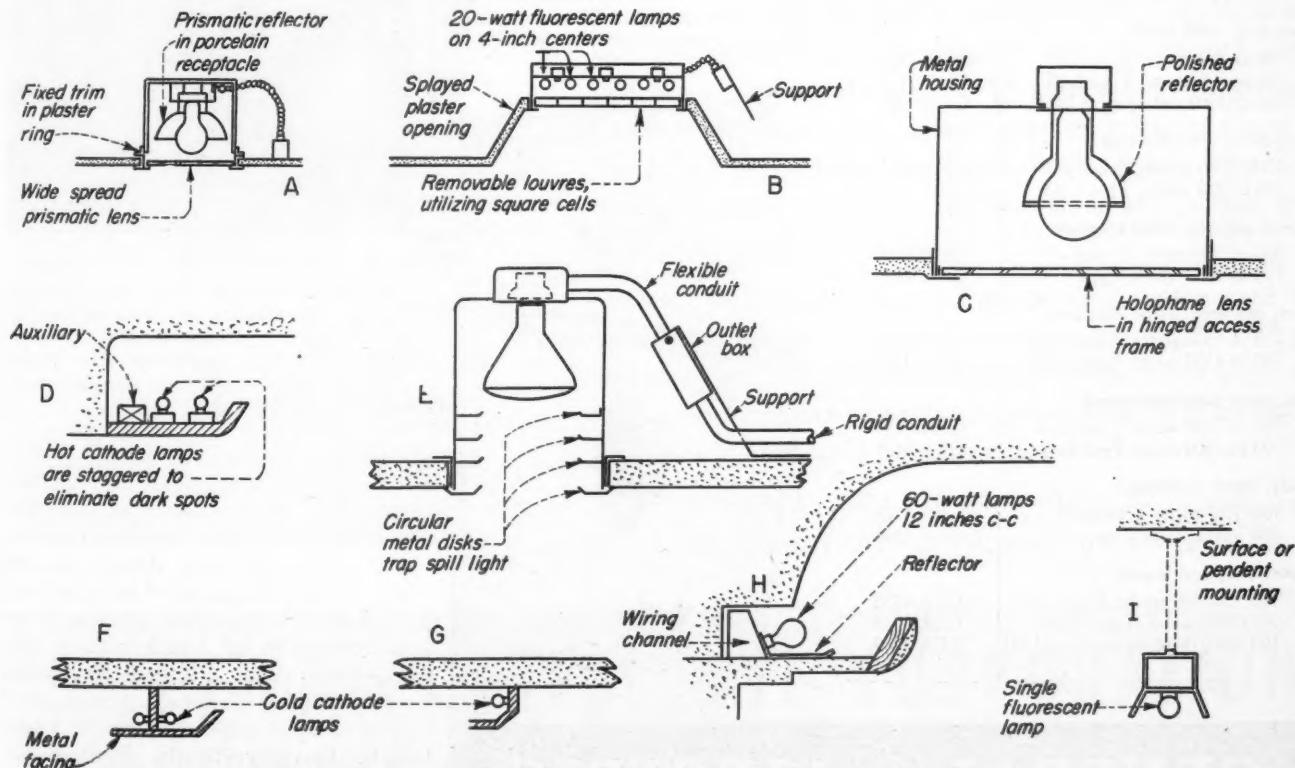
Lighting Designed For Selling

Smart lighting is utilized as a vital architectural component in the most recent retail link of the Crawford Clothes chain. Occupying the entire Broadway blockfront between New York City's 33rd and 34th Streets, this modern clothing showplace employs lighting for decoration as well as for functional utility, with over 36 different lighting applications combined in the illumination plan of the large showrooms, offices, fitting rooms and alterations department. Depending upon the varied functions of the several areas, the decorative effects to be created and the desired intensities and colors of the lighting, a variety of fixtures and cove treatments are used for general illumination, display lighting and business or merchandising requirements. A total of 284 lighting circuits serve the three-level area, 126 circuits automatically regulated by clocks and contactors, resulting in a distribution system that

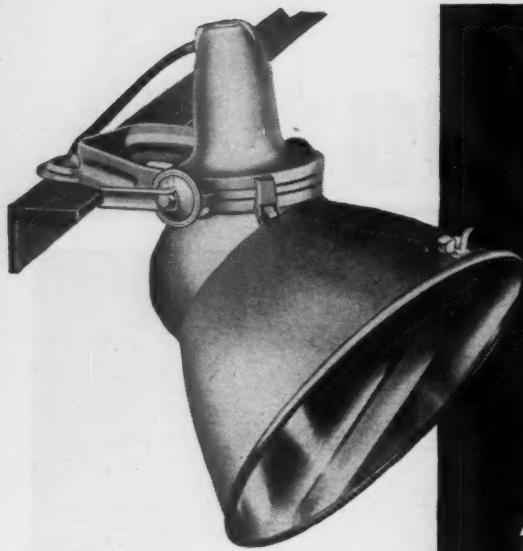
gives both flexibility and control with a minimum of attention from maintenance or engineering personnel. Modern design is also carried to the selection of structural materials. The store is faced by white marble that arches upwards and outwards from the recessed show windows to form an arcade over that section of sidewalk located within the building line. The marble then rises to mezzanine height as a backing for white, luminous, high voltage display lettering. Metal-sheathed soffits over all-glass entrances give way to a spacious interior where liberal use is made of vari-colored metals, mirrors, wall motifs, woods and painted surfaces. While much of the purely functional lighting is installed in areas restricted to store personnel, an examination of the merchandising and display areas offers a variety of lighting treatments that are both representative and comprehensive.



1) General illumination in high-ceiling sales areas is supplied by square fluorescent units (B) utilizing eggerate louvres and splayed plaster ceiling treatments, and high-wattage incandescent downlights deeply recessed in metal housings fitted with black discs for trapping all spill light. The edges of the dropped ceiling are cove lighted (D) by double rows of hot cathode lamps with staggered ends to eliminate ceiling dark spots.



Incandescent, standard fluorescent and cold cathode illuminants are used as direct light sources, for cove treatments, diffused by prismatic lenses and shielded by louvres. Both functional and decorative purposes were considered in designing fixtures and selecting wattage and color.



Type L-69, sports and area floodlight

Call

for

FLOODLIGHTS

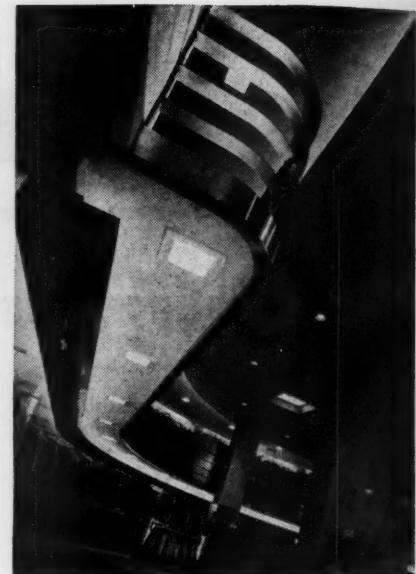
... and get these
important advantages

- ★ Proper types and sizes for all applications
- ★ High-efficiency, the result of scientific design
- ★ Long life and low maintenance expense
- obtained through sturdy construction
- ★ Expert assistance with application problems, backed up by 30 years' experience
- ★ Convenient sales and service facilities

WANT THESE HANDY DESCRIPTIVE LEAFLETS FOR YOUR PROPOSALS?

FLOODLIGHT	PUBLICATION
Heavy-duty, steel casing 200 or 250 watts, Type L-29 300 or 500 watts, Type L-30 750 or 1000 watts, Type L-31	GEA-4303 GEA-4304 GEA-4305
Heavy-duty, cast aluminum 1000/1500 watts, Type L-34 200 or 250 watts, Type L-38	GEA-4517 GEA-4325
General purpose, sheet aluminum 300 or 500 watts, Type L-49 750 or 1000 watts, Type L-43	GEA-4311 GEA-4310
Sports and area, sheet aluminum 750 to 1500 watts, Type L-68 750 to 1500 watts, Type L-69	GEA-4333 GEA-4590
Area, open porcelain enamel 300 to 1500 watts Type L-45 300 to 1500 watts Type L-46	GEA-4433 GEA-4434
Randy, sheet aluminum 100/150 watts, Type L-65 200 watts, Type L-66	GEA-4516 GEA-4346
Underwater, cast bronze 100/250/400 watts, Type L-33 500/1000 watts, Type L-39 500/1000/1500 watts, Type L-41	GEA-4438 GEA-4518 GEA-4439

Order individually by number, or in sets, from the G-E Apparatus Sales Office or Agent that serves you. Or write General Electric Company, Schenectady 5, N. Y.



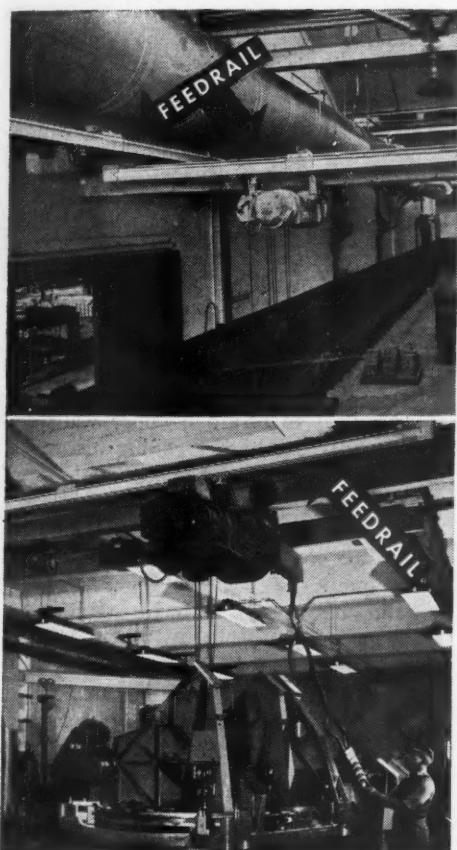
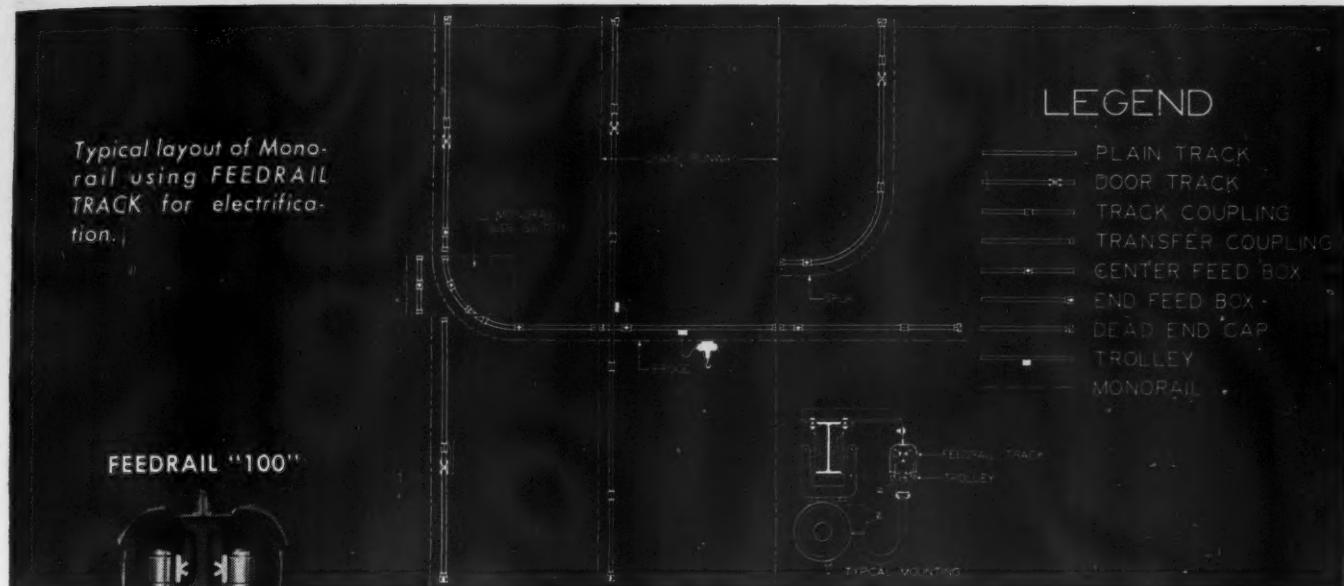
Incandescent lamps with either prismatic or polished reflectors (A and C) are recessed into ceilings above and below balcony behind wide-spread prismatic lenses set flush with ceiling levels. Cold cathode cove lighting (F and G) illuminates clothing displays.



High voltage luminous display lettering is used in both bare and diffused stages. Downlights in metal soffits insure sufficient illumination on sidewalks. All-glass entrances turn entire store interior into huge display and attractive sales area.

General illumination throughout the high-ceiling sales areas combine the use of incandescent and standard fluorescent lamps. Each fluorescent unit (B), square in design, mounts six 20-watt lamps on 4-inch centers, shielded by removable eggcrate louvers composed of 3-inch square cells 1½-inches deep. Fixtures are located several inches above the ceiling level with splayed plaster openings rising to the louvre gridwork. Incandescent units in these same areas utilize high-wattage parabolic aluminized reflector lamps, mounted in deep, circular metal

GENERAL  **ELECTRIC**



ELECTRIC FEEDRAIL

FOR

CRANES - HOISTS

and MONORAIL SYSTEMS

Electric Feedrail is the distribution system that has done away with the hazards and production hold-ups always present with the open wire system. The all-steel casing enclosing the Feedrail bus bars and trolleys protects both men and machines and eliminates stoppages due to falling dust. Large contacts under positive pressure of spring action insure continuous electrical contact.

Feedrail has been endorsed by leading crane and hoist manufacturers for more than ten years. It is approved by the Underwriters' Laboratories. Special curved track and transfer sections and numerous accessories have been developed by Feedrail especially for crane and hoist service.

ASK FOR THESE CATALOGS: General No. 20, Needle Trades No. 16, Machine Tools No. 17 and Portable Tools No. 18.

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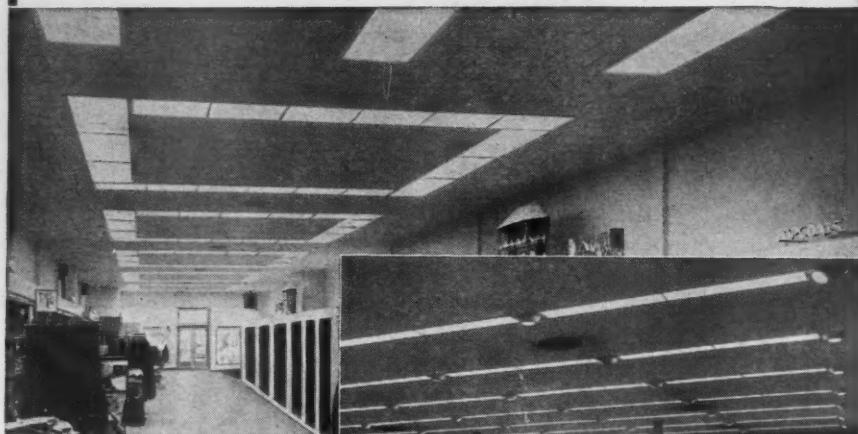
**ELECTRIC
FEEDRAIL**

FEEDRAIL CORPORATION

Subsidiary of Russell & Stoll Company, Inc.

125 BARCLAY STREET • NEW YORK 7, N.Y.

PLANNED LIGHTING WITH WILEY RECESSED TROFFERS

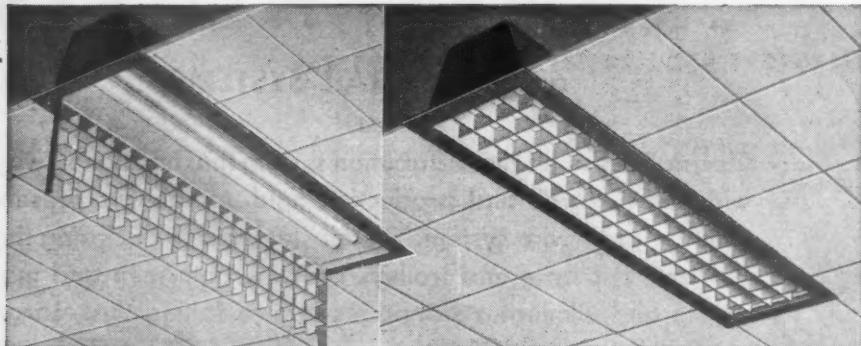


*Wiley Recessed Troffers
in unusual patterns*

Wiley stock model Recessed Troffers provide custom-made results both in lighting requirements and flexibility of arrangement to fit any architectural plan without custom-made costs.



*Wiley Recessed Troffers Combined with "Spots"
in continuous runs.*



Only Wiley has the
E-Z SERVICER

Pat. #2427084

One-man service . . . No Tools.
Raise one side, slide sideways
and drop open. Unhook to completely remove.

FEATURES, UNIVERSAL UNIT:

- Adaptable to any position.
- Individual or continuous runs or patterns.
- Open, louvered or glass.
- May be combined with Wiley Spots.
- 2, 3 or 4 lamps—Starter or Instant Start.
- Underwriters Approved.

Other WILEY Fixtures:

NIAGARA FLEUR-O-LIERS: 2, 3, 4 or 6 lamps, louvered or glass bottoms. May be suspended from or mounted flush to ceiling, singly or in continuous runs.

NIAGARA BEAM: 2, 3, or 4 lamps, louvered or glass. Flush to ceiling — Singly or continuous runs.

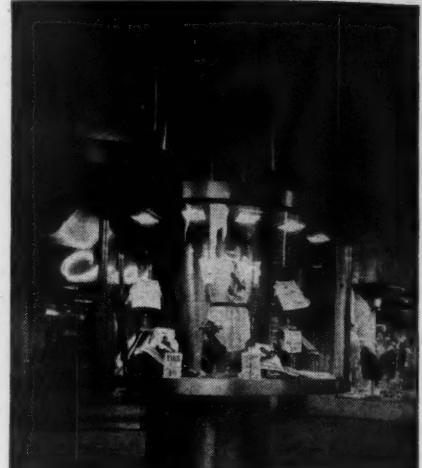
SPOTS: Adjustable or fixed lens. May be used individually or combined with Wiley Commercial or Troffer models.

INDUSTRIAL FLUORESCENTS: Complete high quality line, open, louvered or glass bottoms.

R. & W. WILEY, INC.

Dearborn at Bridge Street

Buffalo 7, N.Y.



High-wattage incandescent lamps, behind Holophane lenses set flush with tops of foyer display cases, provide strong downlight to punch-light advertised merchandise. Liberal use of metal and glass adds modern note to white marble trim.

housings (E). Shielding is provided by series of black-surfaced metal rings that trap all spill light and project narrow-angle cones of light to the floor level.

Set flush with ceilings both above and beneath the surrounding balcony, metal-framed wide-spread prismatic lenses shield standard PS incandescent lamps in either prismatic or polished reflectors (A and C).

Interior cove lighting utilizes single runs of cold-cathode tubing above and in front of all clothing racks (F and G) to illuminate the displayed merchandise, and double rows of standard hot cathode fluorescent lamps around the edges of the central dropped ceiling (D) to brighten upper walls and the adjacent higher ceiling areas.

Unique wall motifs are highlighted by column-mounted PAR lamps in streamlined, spun-metal reflectors, while merchandise in glass sales counters is locally illuminated by slimline fluorescents in narrow reflectors located beneath the aisle edges of the glass counter tops.

General illumination for show windows is provided by two overhead rows of PAR lamps mounted on 8-inch centers, shielded by deep wooden louvres. Pipe racks across the rear ceilings, also deeply shielded, provide mounting facilities for additional flood and spotlights. Floor receptacles furnish yet another power source for special window lighting equipment.

The arched surfaces of the white marble arcades are lighted by cove installations located above the show windows. By using incandescent lamps mounted on 12-inch centers, the blanket of light is relatively even and remains constant in light output regardless of outdoor temperatures.

SENSATION of Chicago's International Lighting Show

COMPETITORS PRAISED IT... WHOLESALERS WANTED IT...

HOLDENLINE
Arrowhead
COMMERCIAL
FLUORESCENT

PATENTS APPLIED FOR

CATALOG NO. CP-240



THE FIRST all-plastic louvering for commercial use.

First fluorescent commercial unit exhibiting controlled brightness without contrast.

First unit in which overall brightness positively eliminates too dark or too bright areas.

Like a correctly designed globe around an incandescent lamp, this new plastic fixture thoroughly shields the light source to produce amazingly new evenness of light quality.

Yes, the exciting new HOLDENline Arrowhead commercial with both sides and louvers made of exactly the same material, identical in color and

quality, is wholly free from the color contrasts created by the inevitable conflicts in combinations of wholly dissimilar materials.

Others are sure to discover this secret eventually, but only HOLDENline Arrowhead commercial fluorescents offer its amazingly important lighting advantages to you now!

Under any normal conditions the HOLDENline Arrowhead *will not warp, sag or otherwise distort—will not discolor.*

The Arrowhead retains all the versatile features of the Chan'l-Run Basic Unit system.

Fits every commercial lighting need—meets and beats school lighting specifications . . .



HOLDENLINE CO.

Pioneers in Fluorescent

2301 SCRANTON ROAD • CLEVELAND 13, OHIO

HOLDENLINE ARROWHEADS

- 1. Low surface brightness—about 1 cp. per square in. on sides
- 2. Rigid All-Plastic Louvers
SELF-LOCKING
NON-WARPING
- 3. Easily removed or attached for quick, easy maintenance
- 4. Surface or pendant mounting

Vaportight INDUSTRIAL LIGHTING FIXTURES



Dependable lighting in the presence of dirt, gases, and moisture is assured by the substantial protection built into Pyle-National Vaportight Pylets. Heavy cast metal bases, weathertight sealing, and heavy guards, are features that provide for the most severe operating conditions of industrial service.

The Pylet line includes a complete range of types, including types for conduit and wall mounting, universal 4- and 5-hub types, two and three gang, handrail and outlet box fixtures for 10 watt to 200 watt lamps. Also Midget fixtures, Vaportight plugs and receptacles, switches, junction boxes and other styles. Consult your Pylet Catalog 1100 for complete listings.

THE PYLE-NATIONAL COMPANY

1344 N. Kostner Avenue, Chicago 51, Illinois

Moreover, a certain amount of visual warmth is imparted to the white surfaces by these filament sources.

Walking safety is provided to pedestrians through the use of deeply recessed lamps (E) shielded by multiple discs and mounted in the upper arches adjacent to the building lines.

This modern store is a creation of

architects Kahn and Jacobs. The distribution system and lighting plans were prepared and installed under the supervision of Edward E. Ashley, consulting electrical engineer for the project. The electrical contracting firm was the Broadway Maintenance Company. The Reinstein Construction Company was the builder.

Display Lighting For Yarn Showroom

New and dramatic techniques in retail wool yarn displays are revealed by James Lees and Sons Company in their New York City showroom. The riot of color inherent in the yarns on display is backed by neutral shades of carpeting and wall decor; grey-beige on the floors with accents of terra cotta on walls. Furniture and display counters are natural oak while upholstery combines dark olive, browns and fabrics matching background tones. In the main showroom area, display fixtures, specially designed by Raymond Loewy Associates for customer appeal, use glass, plastics and woods to accommodate the balls of yarn, instruction books and finished products.

General illumination is a combination of recessed fluorescent and incandescent units. The entrance rotunda is lighted by concealed cove lighting which edges the circular dropped ceiling. Recessed spotlights in the ceiling and additional spotlight units shielded by the lip of the ceiling canopy produce accent lighting for the display of woolen garments. Three types of illumination are found in the showroom. PAR-38 incandescent lamps are recessed into the ceiling over the central display counter; spotlights in spun-metal bullet-shaped reflectors are suspended above wall dis-

play racks, and deeply-louvered fluorescents are recessed above a special wall display. Panels of frosted glass on either side of this special display are back-lighted by fluorescents so placed that lamp images are not apparent on the frosted surfaces.



Rotunda is illuminated by cove lighting shielded by lip of circular dropped ceiling. Recessed spots in ceiling and auxiliary high-wattage spots hidden by canopy accent displays on walls and in specially designed glass counters. Design of showrooms and lighting plans were created by Raymond Loewy Associates.



Main showroom of James Lees' new yarn center in New York City is lighted by recessed PAR 38 lamps above center island display counter, by suspended bullet spotlights in front of wall skein racks, by recessed fluorescents above deeply-louvered grid, and by frosted glass panels with fluorescent back-lighting.

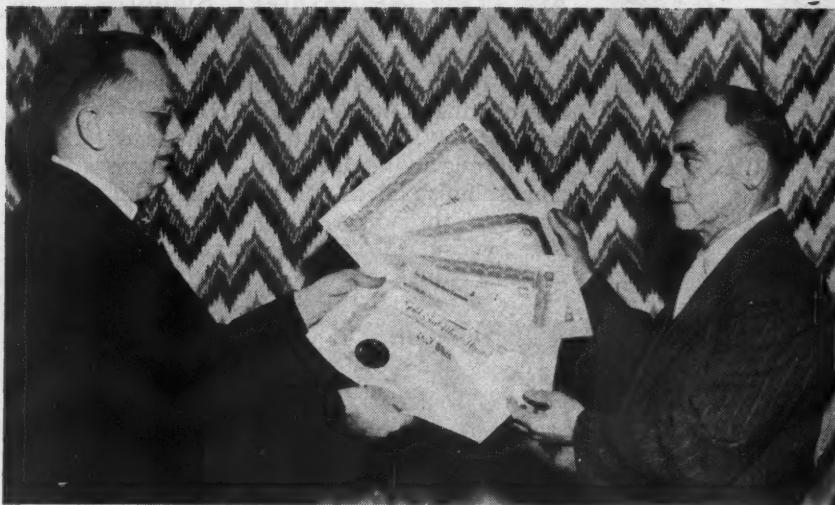
In the News

2nd International Lighting Exposition and Conference

The new, industry-wide *Planned Lighting* program is on the march! This was readily apparent and superbly demonstrated at the 2nd International Lighting Exposition and Conference, held at the Stevens Hotel, Chicago, on November 3-7, 1947. Sponsored by the Industrial and Commercial Lighting Equipment Section of The National Electrical Manufacturers Association, this Exposition and Conference was attended by more than 8500 illuminating engineers from all branches of the industry, architects, electrical contractors, plant engineers and maintenance men, Federal, state and local officials, owners, electric utility representatives, electrical wholesalers and others.

Contributing to the outstanding success of this week-long Exposition were three major activities comprising the center of interest: 1) announcement of Gold Seal Merit Award and Merit Award Certificate winners in the Merit Award Competition for Planned Lighting installations; 2) the Conference program consisting of a series of four lighting conferences and round table discussions; and 3) exhibits by manufacturers of industrial and commercial lighting equipment, lamps and bulbs, paint, and many other products which are directly related to lighting and to maintenance of lighting systems and equipment.

Lighting Exhibits. Ninety-seven exhibitors, occupying 161 superbly-lighted display booths, displayed their new products, popular older designs, and many lighting components which are expected to form the core of the *Planned Lighting* program. The question most commonly asked by visitors seemed to be "What's new at the Show?" Using the 1st International Lighting Exposition, held in April, 1946, as a reference point, visitors could find a variety of new products, new lighting components and new ideas and techniques in the various exhibits. Some highlights of the Show are summarized here, in an effort to indicate the trend in lighting as reflected by the Show, and what the industry is producing to meet the biggest market in its entire history.



Triple honors in the Merit Award Competition at the Second International Lighting Exposition went to E. J. White (right), president, Edward J. White Company, electrical contractors, Newark, N. J. He was one of three contractors awarded Gold Seal Certificates (for an industrial lighting installation) in the nation-wide contest; also copped two merit award certificates for an office and laboratory lighting job. Here, he receives his awards from Carl Zersen (left), chairman, Merit Award Committee, at the Chicago exposition.



Contractor Merit Award Winners present at the opening of the Second International Lighting Exposition Chicago are: (L to R) Oral C. Craft, F. H. McGraw and Co., Pittsburgh; John O. Kvalsten, Kvalsten Electric Co., Inc., Minneapolis; Leo W. Witz, Continental Electrical Construction Co., Chicago; and E. W. McCall, Tennessee Armature & Electric Co., Knoxville (two awards). Other winners not in photo were: Orville R. Nichols, A. C. Electric Co., Inc., Milwaukee (three); E. J. White, Newark, N. J. (two); and James Harris, Kingston, Ontario, Canada.

Nearly all producers of fluorescent luminaires showed one or more models for use with the new, more efficient long slim lamps, or told of new models on the way. New fluorescent luminaire designs were in general functional in design, with a minimum of applied decoration and ornamentation. Almost all fluorescent units were designed for installation both individually and continuous-row or pattern mounting. Housing units for incan-

descent reflector-type lamps were shown by most fluorescent luminaire manufacturers, so designed that lamps have universal adjustment, and so that units may be installed individually or combined with the fluorescent luminaires. Several manufacturers also exhibited various styles of individual housings for reflector-lamps, such as adjustable "bullet" housings for outlet box, ceiling or wall, or suspension mounting.

A Complete Line of Electrical Fittings!

Malleable Iron means a lot in reducing installation time!



ASK YOUR WHOLESALER! Smooth fit—that can be the difference between just breaking even and good profits on a job. No wasted time forcing or cleaning obstinate fittings. GEDNEY Fittings fit . . . because they're made of high grade malleable iron. They have smooth finish inside and out, with clean, accurate threading. Next time, start your wiring job right—install GEDNEY Fittings.

GEDNEY FITTINGS



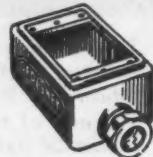
CONDUIT NIPPLES



EMT SERVICE CAPS



CONDUIT COUPLINGS



EMT BODIES



THREADED CONDUIT BODIES



WATERTIGHT BOX CONNECTORS



ANGLE CONDUIT INSULATORS



EMT CONDUIT BODIES



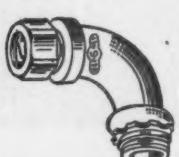
CORD GRIPS &
PVX CONNECTORS



GROUND FITTINGS



SQUEEZE CONNECTORS



EMT 90° ELBOW CONNECTORS



WRITE FOR THE 62-PAGE GEDNEY CATALOG!

It's all there—every GEDNEY item clearly indexed, with every size and type for your job. This manual will save you plenty of time because it has been made up to give you information . . . fast! Send for your copy; write on company letterhead.



GEDNEY ELECTRIC CO.

RKO BLDG., RADIO CITY, NEW YORK 20, N. Y.

FOUNDRY, FACTORY & SHIPPING POINT: TERRYVILLE, CONN.

The relatively new "louvered" ceiling, which consists of a series of latticework louvers designed to form an all-luminous ceiling and to shield light sources installed above, was displayed in a few booths. SkyGlo, a plastic "luminous louver ceiling system", was shown for the first time by Benjamin Electric Mfg. Co. (Des Plaines, Ill.), which was acclaimed generally as a new contribution to the art of lighting. Other manufacturers who produce louvered ceilings made of metal louvers, and have made installations in several commercial establishments, also had such systems on display.

Several new designs of commercial and industrial fluorescent lighting units were shown at the Show for the first time, and created considerable interest and comment. A very shallow glass-enclosed commercial unit for 2/40-watt fluorescent lamps was shown by Smithcraft Division, A. L. Smith Iron Co. (Chelsea, Mass.) Reported to be the first such unit to be produced, it is designed for individual or continuous-row mounting, and for either close ceiling or suspension mounting.

An all-plastic commercial 2/40-watt fluorescent fixture was exhibited by The Holdenline Co. (Cleveland), in which plastic is used both as a reflector and as a diffuser. This unit is also designed for individual unit mounting, or for continuous-row installations, and may be either ceiling mounted or suspended.

Two new fluorescent troffer units were shown by DayBrite Lighting, Inc. (St. Louis). One was a 2/40-watt lamp unit in which the reflector is specular aluminum and has an aluminum finished louver for shielding

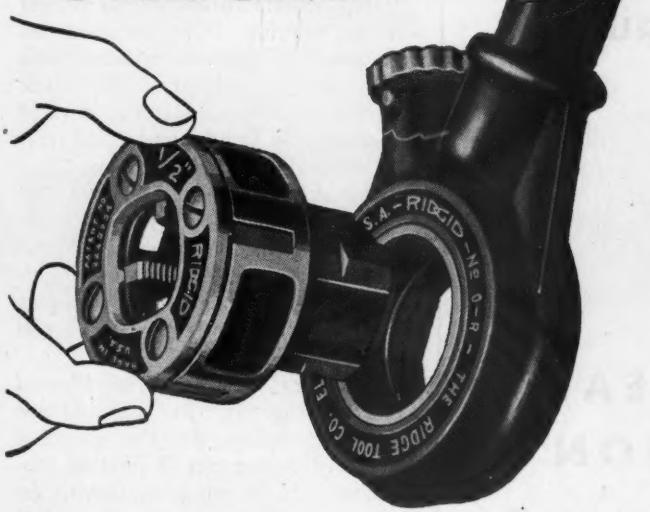


Seeking the latest information on electrical estimating and cost data at Lighting Exposition are: Charles Hellndoerfer (left), Helldoerfer & Castellini, Dayton, Ohio contractors; and Charles W. Wright, electrical engineer, Delco Products Division, General Motors Corp., Dayton, Ohio. Ray Ashley (center) explains charts and tables compiled by the research department of the Electrical Contractors Association of the City of Chicago.

HOW TO MAKE *Short work* OF PIPE THREADING

Clean threads fast on $\frac{1}{8}$ " to
 $1\frac{1}{4}$ " pipe with these smart little

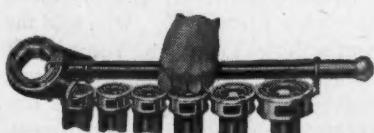
RIDGIDs



● Light, strong, efficient, **RIDGID** Nos. 0R and 11R ratchets give you quick perfect threads on $\frac{1}{8}$ " to $1\frac{1}{4}$ " pipe or conduit. Snap the size die head you want into the ratchet ring—it can't fall out. No special dies needed for close-to-wall threads. Precision cut tool-steel dies. No. 0R, $\frac{1}{8}$ " to 1"; No.

11R, $\frac{1}{8}$ " to $1\frac{1}{4}$ ".
Buy at your Supply House.

Free handy carrier for
any group of sizes.



Guaranteed TO SAVE YOU PIPE WRENCH EXPENSE

UNCONDITIONAL GUARANTEE
If this Housing ever
Breaks or Distorts we
will replace it Free
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THE RIDGE TOOL CO.
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No wrench housing
repair cost — or
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RIDGID

● It's powerful, it's easier to use, it's trouble-free — and that guaranteed housing practically ends upkeep expense. Like millions of users, you enjoy the easy spin of the adjustment nut in all sizes, 6" to 60," positive action jaws, handy pipe scale on hookjaw and comfort-grip I-beam handle.



RIDGID Strap Wrench pro-
tects polished pipe.

For efficiency and low cost,
it pays you to buy the
popular **RIDGID**—see it
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RIDGID

WORK-SAVER PIPE TOOLS
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Just like picking the

**BRASS
RING!**

**Your Luck With Fuses
Improves When You**

Specify

MONARCH *Renewable Fuses*



**BUILT WITH AN ADEQUATE
AMOUNT OF**

BRASS

for

**BETTER HEAT
DISSIPATION**

Completely Approved

**•
Complete Line of
Knife Blade & Ferrule
Types**

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Simple to Renew**



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both parallel and normal to the lamps. The other troffer was a combination 2/40-watt lamp lighting unit and air conditioning outlet, with air conditioning unit being made by Barber-Colman Co. (Rockford, Ill.).

A new 4/40-watt fluorescent lamp explosion-proof and dust-tight fixture was exhibited by Crouse-Hinds Co. (Syracuse, N.Y.). It is also available for either two or three 40-watt fluorescent lamps, the manufacturer stated. While explosion-proof fluorescent units are not new, this unit showed considerable development progress in this field.

Westinghouse exhibited a new mercury vapor street lighting luminaire, designed for horizontal mounting of the mercury lamp, and equipped with a special shape Holophane prismatic glass refractor for light control.

New floodlighting units and airport lighting equipment were demonstrated by various exhibitors. Paints, finishes, plastics, maintenance ladders, dimming and control devices, ballasts, etc., and other allied lighting components were displayed by various other manufacturers.

Lamp manufacturers displayed light sources ranging from standard incandescent and fluorescent lamps to the newer slimline, circline, half circle fluorescent, reflector lamps, infrared and ultraviolet light sources, and mercury vapor light sources.

Also on display were the Gold Seal Merit Award and Merit Award Certificate lighting installation entries, showing the application of many of the lighting units and components on display by the various manufacturers to actual lighting installations.

Conference program. The *Planned Lighting* program, what it is and how it is being applied, was the subject of the four-day program of lighting conferences held in conjunction with the Exposition. Speakers on these programs represented all segments of the lighting industry, including manufacturers, electric utilities, wholesales, contractors and users.

"Trends and Progress in Lighting" was the subject of the first day's program, chairmanned by R. W. Staud, president, Illuminating Engineering Society. First speaker on this program was George Whitwell, vice-president, Philadelphia Electric Co., who told the delegates how to "Plan Tomorrow's Lighting Today". Ward Harrison, manager of General Electric Co.'s Engineering Division, Lamp Department, discussed the probable trend of developments in light sources, and indicated improvements in efficiency to be expected, in his talk on "Lighting Beyond Tomorrow". He also forecast the long-range outlook for lighting in homes, offices, schools and industrial plants, and estimated the market pos-

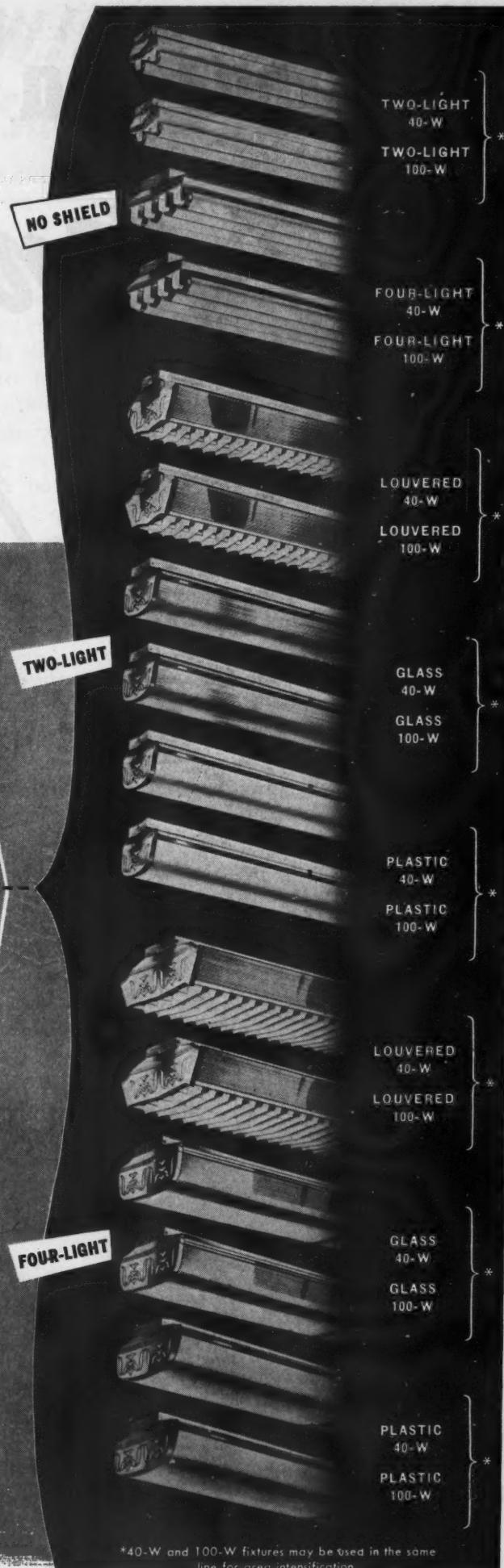
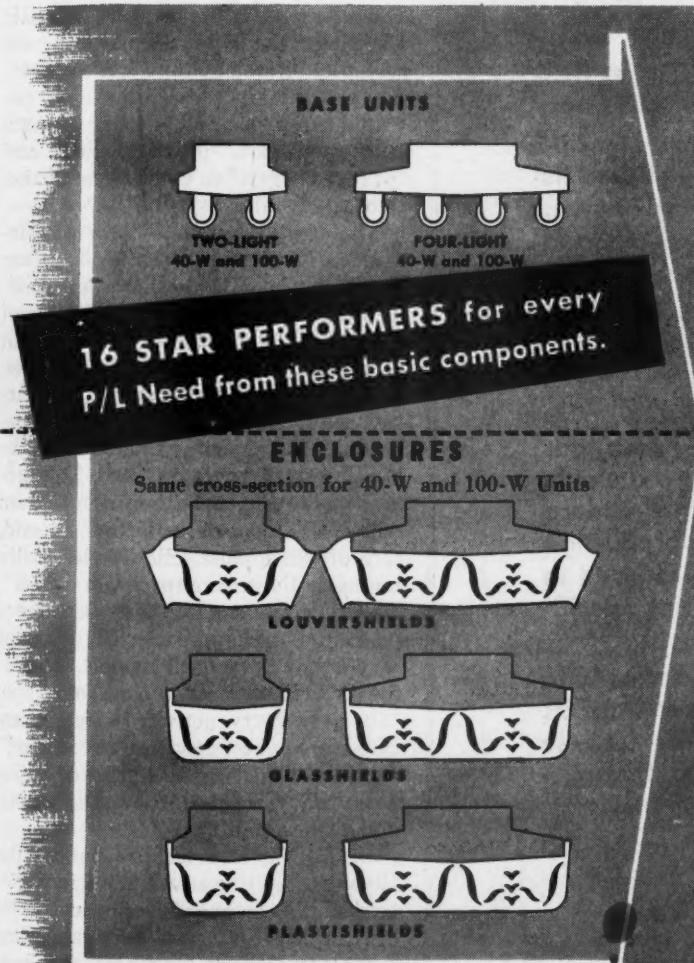
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Lifetime /

After only one year of active production, Slater has achieved significant stature as a manufacturer of wiring devices.

Slater

Like a new kid on the block, Slater a year ago offered its products in competition with those of a long known, highly respected group of suppliers, whose markets had seen no new face in two decades.

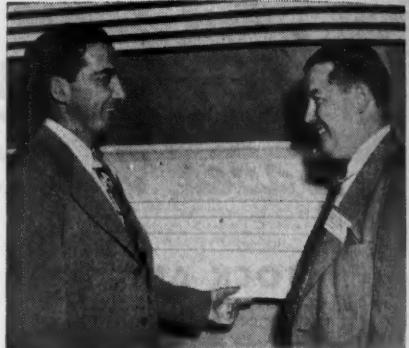
In a short twelve months, Slater has enjoyed twice the volume of business projected for itself, doubled the number of devices initially in its line.

Slater's top management is thoroughly experienced in this field. Its engineers and production men learned their jobs in the birthplace of the wiring device industry—the plants in New England and the Connecticut Valley. Its modern new plant includes the latest developments in production machinery. Slater products are top-quality, produced in full compliance with Underwriters' Laboratories' specifications.

To the wholesalers, contractors, and manufacturers who have shown such great confidence in us and our products during this first year, our sincere thanks; and the promise that Slater will continue to grow in their service throughout its LIFETIME.

Slater
ELECTRIC & MFG. CO.
56th STREET and 37th AVENUE, WOODSIDE, N.Y.

Lifetime wiring devices



Contractors Paul T. Bryant (left) and George W. Williams of Bryant Electric Co., High Point, North Carolina, look over cold cathode lighting exhibit (General Luminescent Corp.) at Chicago lighting exhibit.

sibilities for fluorescent equipment in the various fields.

"Dynamic selling needs dynamic men with dynamic vision", said Don G. Mitchell, president, Sylvania Electric Products, Inc. in his talk on "Dynamic Lighting Sales". He described the opportunity offered by the *Planned Lighting* program in terms of market potential estimates, and warned it would take more than "peanut selling" and "peanut budgets" to convert the market into actual sales.

The second day conference was devoted to "Industry Plans for Lighting Promotion". The session was chairmanned by Merrill Skinner, director of sales for Union Electric Company of Missouri. First speaker at this session was J. S. Schuchert, manager, commercial sales, Duquesne Light Co., Pittsburgh. His subject was "How to Make the Lighting Program Click". The success of the *Planned Lighting* program will depend upon three factors, he said, each of which must "click" individually to make the entire program "click". These factors are: (1) a positive mental attitude and approach; (2) national support; and (3) local support. He defined the *Planned Lighting* program as "an all-industry activity which many consider the best cooperative "natural" ever developed", and reviewed what has already been done by the various trade associations.

L. E. Tayler, vicepresident of the Illuminating Engineering Society, described the technical and educational data which I.E.S. provides, and how these data can be used. He also outlined the aims and objectives of the Society, and defined it as "the keystone of lighting progress".

Thomas F. Coghlan, electrical engineer in charge of illumination for the Public Buildings Administration, Federal Works Agency, Washington, discussed "Practical Consumer Planning". The PBA is developing fixtures for both fluorescent and incandescent lamps to meet the specific lighting require-

ments for areas common to most Federal buildings, he said. Their objective in fixture design is inconspicuousness of the lighting equipment, he added, with emphasis on maintenance.

E. C. Huerkamp, Westinghouse Electric Corp., and chairman of the Exposition Operating Committee, told of the "New NEMA Plans for Lighting Promotion".

The Conference session on the third day was devoted to "How the Electrical Wholesaler Can Increase His Lighting Sales". Charles G. Pyle, NEWA managing director presided.

D. L. Fife, president, Fife Electric Supply Co., Detroit, stated that the lighting market has never been more than one-quarter sold, in discussing the "New Lighting Markets for Electrical Wholesalers", and stressed wholesaler activity in the *Planned Lighting*, Certified Lamp Makers, and American Home Lighting Institute programs. H. P. Litchfield, Graybar Electric Company, discussed "Practical Merchandising for Wholesalers". J. M. McKibbin, assistant vice-president, Westinghouse Electric Corp., described "How to Train the Wholesalers' Salesmen", and showed training techniques used by Westinghouse, using lantern slides to show training manuals used, classes in session, models of subjects being discussed, etc. The production rate is today more than twice that of 1939, he stated, which means that it will once again be necessary, soon, to sell through creative effort. O. Fred Rost, editor and publisher of *Electrical Wholesaling*, told wholesalers to "make lighting the foundation of your selling program". The sale of better lighting installations increases practically all other wholesaler items, he stated.

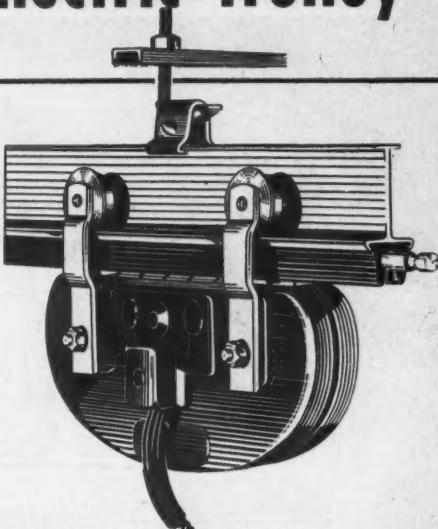
Subject for the last day Conference session was "The Electrical Contractor, the Key Man in the Lighting Plan". Chairman of this session was W. T. Stuart, editor, *Electrical Construction and Maintenance*.

George B. Roscoe, public relations director, National Electrical Contractors Association, told the contractors and Exposition guests that electrical contractors must tie in with the *Planned Lighting* program and do a thorough job of creative selling, or the program will fail to reach its objective. In presenting "A Sound Contractor Selling Program", he outlined the contractor's function as that of surveying, planning, recommending, selling and installing, and urged contractors to keep informed on lighting design and application techniques and to do a greater creative selling job. The contractor's product is "lighting satisfaction", he said, which requires adequate wiring and control in addition to proper design and application of the lighting system.

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The Benbow Trolley System is a revolutionary improvement in the transmission of electric power to motors mounted on cranes, monorails, portable tools, etc. It gives trouble free performance and protection to motors and offers the greatest possible safety to operating personnel. It is not a make-shift "hooding" of the old-fashioned trolley wheel systems.

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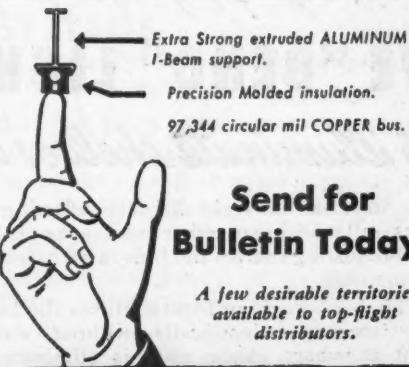
Careful engineering makes the Benbow Trolley System easy to install and maintain. Patented features allow independent conductors to hang open to view but not exposed to accidental contact.

Eliminates Single-Phasing of motors due to positive multi-shoe contact. Motors are protected from overheating, burn-outs, and starting failures.

Non-Arcing because of multi-shoe compression contact of five shoes, rather than the rolling or sliding action of out-moded trolley wheels.

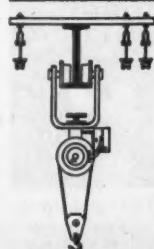
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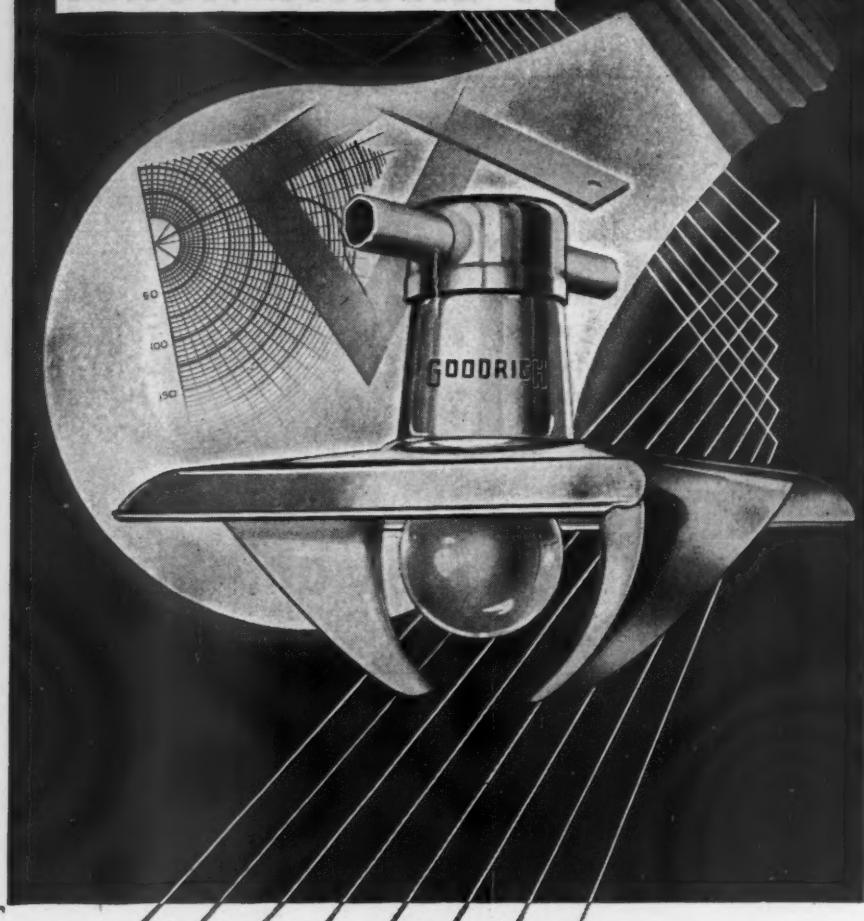
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Leo Gamp, Jr., vice-president, Gamp Electric Co., St. Louis, discussed "The Electrical Contractor's Place in the Lighting Industry". All segments of the lighting industry are working to sell better lighting, he said. He then outlined the types of personnel needed to create the sale, engineer the layout, and to make the installation. He showed that there is considerable duplication of effort under the present system of marketing and distribution. Much of this duplication of effort can be eliminated, he explained, if the manufacturer, the wholesaler and the electric utility will work more closely with the electrical contractor, who can provide *all* the information to clinch the sale.

"Service Maintenance Plans that Work" was the subject of a talk presented by Warren W. Langston, manager of the Fluorescent Lighting & Maintenance Division, The Jack Stone Co., Washington, D. C. Lighting equipment must be properly maintained if the customer is to get the light he pays for, Mr. Langston stated, and a well-planned and operated Maintenance Department can perform this function most efficiently and satisfactorily. He gave the details of organization and operation of such a department.

All-Industry Dinner. The Chicago Section of the Illuminating Engineering Society sponsored an all-industry dinner, which was attended by more than 1200 members and guests. Charles E. Johnson, Chairman of the Chicago Section, IES, officiated. Speaker for this occasion was Dr. Gerald Wendt, editorial director of *Science Illustrated*, who talked on "The Challenge of Science to the Lighting Industry".

Merit Award Competition winners. Seventeen individuals were announced winners of the Gold Seal Merit Awards (\$100). These awards were made covering twelve outstanding *Planned Lighting* Installations, three installations being selected in each of four separate classifications. Five of the installation entries were submitted jointly by two individuals.

In the electrical contractors classification the winners were: Edward J. White, Edward J. White Company, Newark, N. J., *industrial lighting*; George W. Phelps, G. W. Phelps and Co., Boston, Mass., *store lighting*; and Spott Electrical Company, Oakland, Calif., jointly with Donald R. Keebaugh, utility lighting representative, Pacific Gas & Electric Co., Oakland, Calif., *store lighting*.

A total of 183 Merit Award Certificates were awarded to entries in the four classifications as follows: electrical contractors, 21; electrical wholesalers, 22; architects and consulting engineers, 18; and utility lighting representatives, 122.

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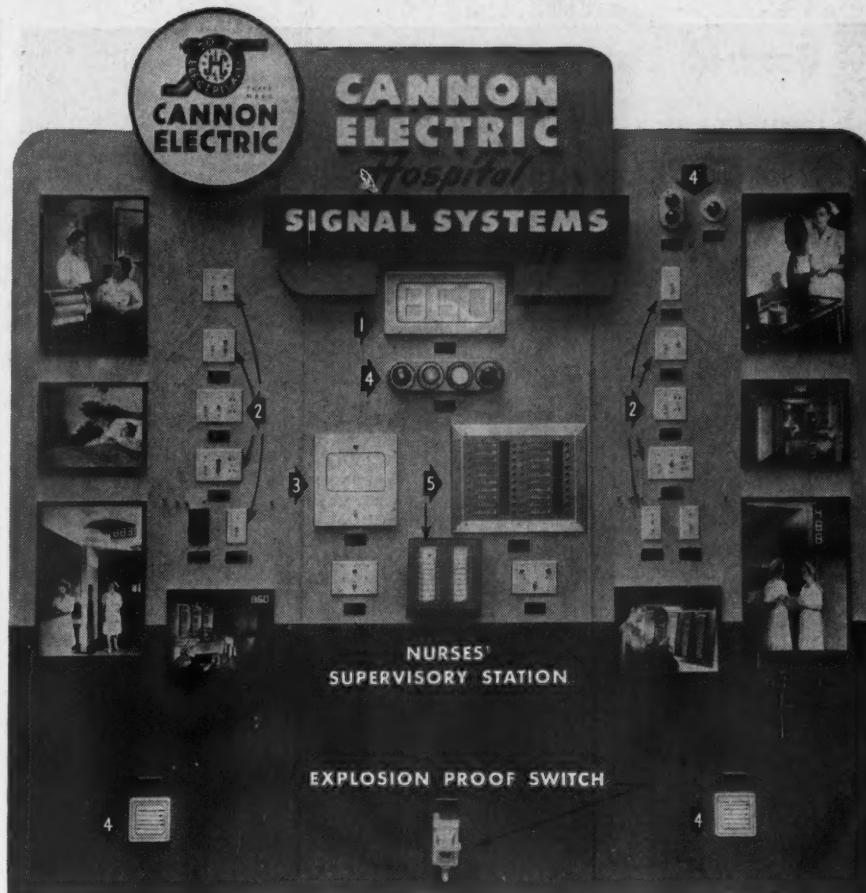
Eastern Section IAEI Holds Annual Meeting

The Eastern Section of the International Association of Electrical Inspectors held its 23rd annual meeting in Atlantic City, N. J., on October 20-22. More than 225 members and approximately 75 others registered for this three-day meeting, held in the Seaside Hotel.

The meeting got off to an early start with a Code breakfast on the opening day, during which discussion of the Code was led by B. A. McDonald, 2nd vice-president of the Eastern Section, and electrical superintendent, New York Fire Ins. Rating Organization, Rochester, N. Y. Questions on many parts of the Code were raised, and opinions on the questions were given by others. One question related to the requirement that lead covered wire now has to be used in wiring gasoline pumps. Mr. McDonald pointed out that Type TW wire is now under investigation for such use by the Underwriters' Laboratories. Another question referred to the type of lighting unit which may be used in the pit of a gasoline service station. It was pointed out that the Code permits any type unit which is adequately protected from mechanical injury. It was further pointed out that the National Fire Protection Association insists on good ventilation in garages, and that inspectors should follow the same rule. The matter of installing lighting units on lifts in service stations was also mentioned, and since the lifts are usually over four feet from the floor, it was agreed that lighting units on lifts need not be explosion-proof.

The morning session program was opened by J. D. Lynett, annual meeting committee chairman, and supt., Bureau of Electricity, New York Board of Fire Underwriters, New York City. A reply to Mr. Lynett's opening remarks was made by Elmer T. Quinn, president, Eastern Section, IAEI, and chief electrical inspector, Department of Public Safety, City of Newark, N. J. Eastern Section Secretary F. N. M. Squires presented his report, and stated that membership in the Section is now in excess of 2000 members. There are 551 active members, he reported, and 1513 associate members. Mr. Squires also reported that W. J. Mahan, electrical inspector, New Haven, Conn., has been made Eastern Section representative and was authorized to attend the annual meetings of all other Sections being held this year.

Section President Elmer T. Quinn, in addressing the meeting urged greater education on Code matters by the membership and the exchange of ideas.



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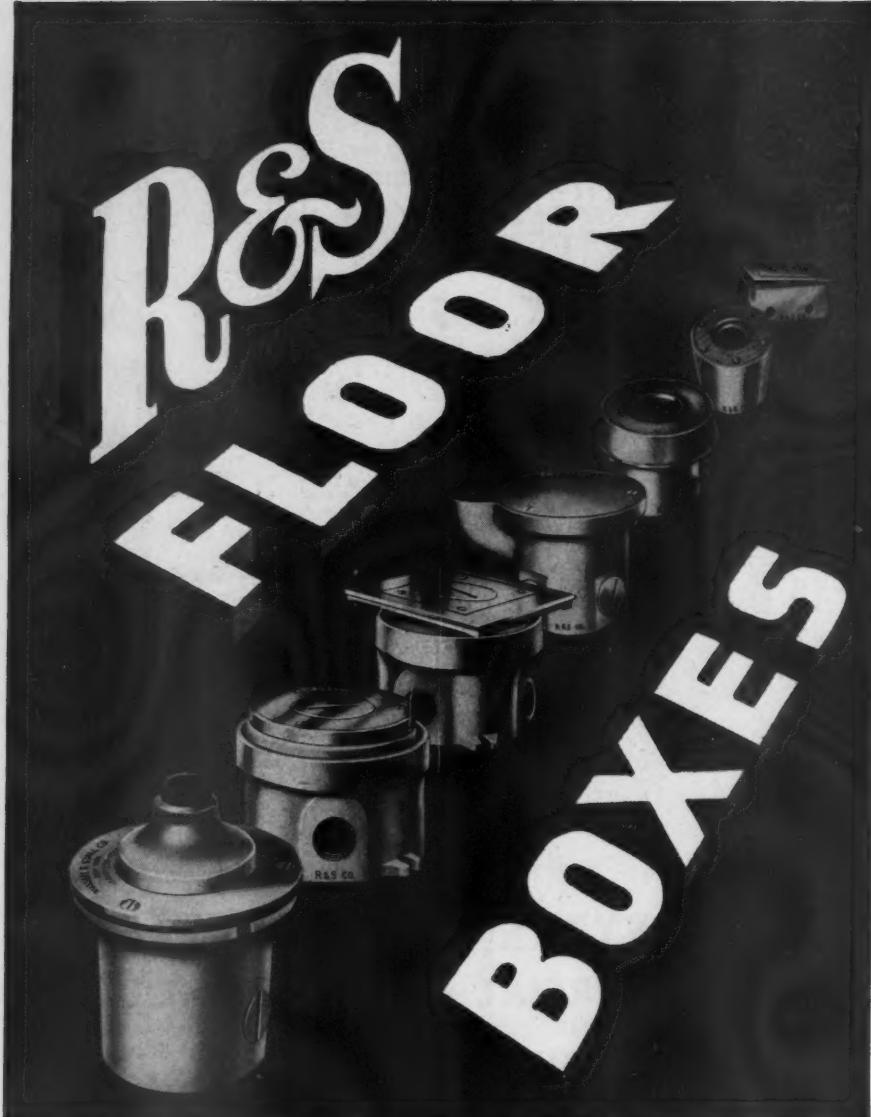
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L. D. Price, manager NEMA Engineering & Regulatory Legislation Departments, discussed the "National Electrical Code and the Electrical Industry" and urged greater standardization of electrical safety codes.

W. R. Volheye, of Portland, Ore., IAEI president, told the inspectors that many new changes in the electrical industry will be forthcoming in the future. "The industry is still in an infancy stage" he declared, and added, "In years to come, and while today's wiring installations are still in use, there will be many new devices and appliances. You inspectors must keep the future in mind when you look over installations of electrical wiring. This means the enforcement of the adequacy provisions of the Code."

V. H. Tousley, secretary-treasurer of IAEI gave his annual report to the Section.

The afternoon session of the first day of the meeting was presided over by Henry H. Daniels, 1st vice-president, Eastern Section. The session consisted of reports of Eastern Section Committees on Articles 210-220, Article 240, Article 250, and a talk on "Grounding on Portable Equipments" by H. H. Watson, standards engineer, General Electric Company. Leo H. Cleary, technical director, NECA, gave an outline of further requirements for Art. 210-220. Closer coordination is needed for figuring wire sizes and circuit protection, he stated. There is also needed a method of calculation of feeders on underfloor duct systems, he pointed out, giving examples of varying procedures now used. He further suggested a Table for both copper and aluminum wire in Section 220.

Floyd S. Green, Frank Adam Elec. Co., discussed the effect of heat on protection devices, and the effect of enclosing fuses and switches in cabinets. Greater ventilation is needed, he said.

C. A. Ward, chief electrical inspector, Paterson, N. J. reported on Article 240, Overcurrent Protection, and A. H. Schirmer reported on Article 250, Grounding.

H. H. Watson, General Electric Co., in his talk on grounding of portable electrical equipment, declared that grounding will eliminate a great many troubles in the use of such equipment. One manufacturer of electric refrigerators has reported no trouble with over 20 million electrically run boxes because of grounding, he stated.

The program for the second and third days of the meeting followed the pattern for the first day, with some variations. Code breakfasts were well attended on both days and inspectors introduced many subjects for discussion. John W. King, electrical inspector of Providence, R. I., led the discuss-

sion on the second day, and Karl S. Geiges, electrical engineer from Underwriters' Laboratories, Inc., New York City, officiated on the third day.

J. L. Wagoner, Westinghouse Electric Corporation, took the mystery out of power factor in a discussion of "The Great Power Factor Mystery". He used a specially designed board on which were installed the necessary meters and loads to illustrate what happens to feeder and line currents when low power factor loads are added, and what happens to these line currents when capacitors are added.

The annual dinner and dance was held on the evening of the second day, with James D. Lynett, chairman of the annual meeting committee serving as toastmaster. Guest speakers on this program were: Hon. John M. Cannella, Commissioner, Water Supply, Gas & Electricity, New York City; A. Lincoln Bush, chairman, Joint Industry Board, New York City; and W. R. Volheye, president, IAEI, Portland, Oregon. A highlight of the banquet session was the presentation of a substantial check to IAEI Secretary-Treasurer V. H. Tousley, who is retiring from the Association after many years of diligent service. This check from the Eastern Section, Mr. Tousley was told, is to be used by him in purchasing something for his woodworking hobby shop.

The Eastern Section's 23rd annual meeting closed with the election and installation of incoming officers. These officers for the coming year are: Henry H. Daniels, Washington, D. C., president; B. A. McDonald, Rochester, N. Y., 1st vice president; A. W. Hopkins, Springfield, Mass., treasurer; F. N. M. Squires, New York City, secretary. The Executive Committee for the coming year will consist of the officers, past president Elmer T. Quinn, Newark, N. J., and three elected members; James D. Lynett, New York City (active member), W. J. Canada, Mountain Lakes, N. J., (associate member), and C. A. Berlebach, New Haven, Conn., (cooperative member). B. A. McDonald, Rochester, N. Y., H. H. Daniels, Washington, D. C., and C. A. Ward, Paterson, N. J. were elected to the Executive Council, IAEI, for a three year term expiring in 1950.

The program for the Eastern Section has in general been followed for all other Section annual meetings. These meetings were: Northwestern Section, Eugene Hotel, Eugene, Ore., Sept. 22-24; Southwestern Section, Mission Inn, Riverside, Calif., Sept. 29-Oct. 1; Western Section, Mount Royal Hotel, Montreal, Quebec, Canada, October 13-15; and Southern Section, Hotel George Washington, Jacksonville, Fla., October 27-29.

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DATES AHEAD

National Materials Handling Exposition—Public Auditorium, Cleveland, Ohio, January 12-16.

Fifth All Industry Refrigeration and Air Conditioning Exposition—Public Auditorium, Cleveland, Ohio, January 26-29. American Institute of Electrical Engineers—Winter general meeting, William Penn Hotel, Pittsburgh, Pa., January 26-30.

8th International Heating and Ventilating Exposition—Air Conditioning Exposition, Grand Central Palace, New York, N. Y., February 2-6.

National Electrical Manufacturers Association—Winter Convention, Edgewater Beach Hotel, Chicago, Ill., March 14-18. Chamber of Commerce—Annual meeting, Washington, D. C., April 27-29.

National Electrical Wholesalers Association—Annual convention, Statler Hotel, Buffalo, N. Y. First week in May.

Edison Electric Institute—Annual Engineering Meetings, Edgewater Beach Hotel, Chicago, Ill., May 3-5.

National Fire Protection Assn.—Annual meeting, Statler Hotel, Washington, D. C., May 10-13.

Edison Electric Institute—Annual convention, Atlantic City, N. J., June 2-4.

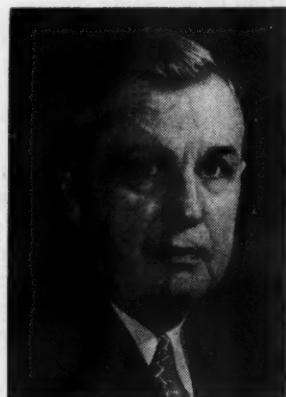
Illuminating Engineering Society—National Technical Conference, Boston, Mass., September 20-24.

National Electrical Manufacturers Association—Traymore Hotel, Atlantic City, N. J., November 8-13.

Manufacturers News

G-E APPOINTMENTS

Murray H. Owen has been appointed manager of sales of the General Electric Company's wire and cable division. Mr. Owen's new position includes his old duties as manager of the York wire and cable section and the duties of



M. H. OWEN

A. E. Newman, formerly manager of sales of the Bridgeport wire and cable section, who has retired.

Ray C. Sanborn has been appointed manufacturing planning engineer for wire and cable division, responsible for all planning activities within the division.

Managers of engineering, manufacturing, and sales for the meter and instrument divisions have been named. I. F. Kinnard is manager of engineering; H. L. Ross manager of manufacturing; and E. H. Howell manager of sales.

Announcement of the welding equipment divisions as one of the new integrated operating units within G-E's

apparatus department was made by R. C. Muir, vice president and general manager of the department.

D. M. Daley has been appointed representative for tungar and metallic rectifiers in the Great Lakes district.

SYLVANIA EXPANDS COMMERCIAL ENGINEERING DEPARTMENT

The Commercial Engineering Department of Sylvania Electric Products Inc. has been enlarged and now includes activities of the company's Lighting Center in New York, according to an announcement made by B. K. Wickstrum, general sales manager of the Lighting Division.

Don P. Caverly, director of the Center, has been named manager of the commercial engineering department, succeeding Harris Reinhardt, who was appointed assistant to the Director of Industrial Relations.

In addition to his new responsibilities, Mr. Caverly, with headquarters in New York, will continue to direct activities of the Lighting Center and has named J. C. Kromhout, architectural engineer, as supervisor. Jan Reynolds, also a member of the Lighting Center staff, has been appointed Home Lighting Consultant.

Charles I. Brady, Jr., formerly division lighting engineer in New York, has been named supervisor on Lamp Division products, and Robert R. Wylie, previously commercial engineer at the Danvers, Mass. plant, has been appointed supervisor on Fixture Division products.

ALLIS-CHALMERS CHANGES

Appointments to a newly created position of manager in charge of both sales and engineering have been made for all sections of the Allis-Chalmers electrical department. Among sections affected by the uniform organization plan is a newly formed electronics section and a substation section formerly called the mixed apparatus section.

H. A. Barthing, who has been assistant manager of industrial sales department, is now manager of the new electronics section, which incorporates sales and engineering functions of the former rectifier section and electronic sales and engineering groups which were previously part of the control section.

L. W. Long is now manager of the substation section, formerly known as the mixed apparatus section, which he had served as sales engineer-in-charge.

Named manager of the firm's motor and generator section is R. M. Casper, formerly engineer-in-charge of sales of the section. G. W. Clothier, who has been engineer-in-charge of transformer sales, has been appointed manager of

FULLMAN

Latrobe

PRODUCTS

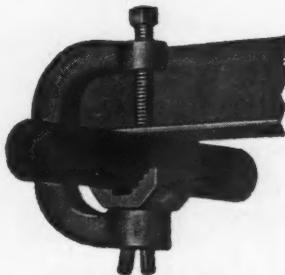


WIRING SPECIALTIES

DEPENDABLE "LATROBE"

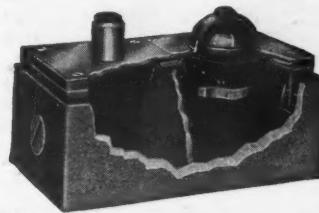
The "Latrobe" line of floor boxes and wiring specialties can be depended on for 100% performance.

"Latrobe" products are easy to install. They are economical. Use "Latrobe" products!



No. 471 "Latrobe"
Pipe or Conduit Hanger

High quality and sure performer yet very economical for hanging pipe or conduit to steel beams. Takes pipe $\frac{1}{2}$ ", $\frac{3}{4}$ " and 1".



No. 252-R Floor Box

A two-gang box with No. 208 Receptacle in one section. One cover plate with $\frac{3}{4}$ " flush brass plug—the other 2".



No. 330 "Latrobe"
Tom Thumb Utility
Outlet

Ideal for use in wood installations and other moisture-free locations.



No. 110 "Latrobe"
Watertight Box

The box body is Iron with $3\frac{1}{2}$ " round Brass cover plate. No. 208 Receptacle and No. 207 Bell Nozzle.



Sold Only Through
Wholesalers

"Bull Dog"
BX Cable Staples

We can furnish these high quality staples in any quantity. Packed in cartons, kegs or barrels.



Keystone Fish Wire

Flat and of high quality properly tempered steel.

FULLMAN MANUFACTURING CO.
LATROBE . . . PENNSYLVANIA

SYNTRON

DEPENDABLE

ELECTRIC HAMMERS

*Speed Up the Job!
Cut down Costs*



when you're Drilling—



Cutting or Channeling
in Concrete and Masonry.

SYNTRON'S patented electromagnetic principle uses only one working part—the PISTON—to produce the high speed hard-hitting blows that save you money and time.

For detailed information
Send this Coupon

SYNTRON CO.
690 Lexington
Homer City, Pa.

Please send illustrated
folder on Electric Hammers to—

Name _____
 Title _____
 Company _____
 Street _____
 City _____
 Zone _____ State _____

the transformer section. Carl W. Bernhard has been appointed assistant to Mr. Casper.

Harry A. Wright has been named engineer-in-charge of control sales of the control section.

HOLDENLINE CO. ELECTIONS

At a recent meeting of the Board of Directors of the Holdenline Co., three changes in the structure of the organization were announced. Dean Holden, president, becomes chairman of the board and will free himself from active company management to devote his full time to all-industry work.

Harry Ingraham was elected president and general manager, and Gary



DEAN HOLDEN



HARRY INGRAHAM

Wise becomes vice president. Prior to joining Holdenline Co., Mr. Ingraham was sales consultant to a number of electrical manufacturers and later associated as a sales executive of the Flexilume Corporation. Mr. Wise was trained in all the major departments of Community Silver at Onieda, N. Y. and in the Lamp Development Laboratory of General Electric at Nela Park, Cleveland.

WESCO APPOINTMENTS

N. A. Hjelte has been appointed general lamp sales manager of the Westinghouse Electric Supply Company at headquarters, New York City. He will have responsibility for lamp sales in



McGILL
LAMP
CHANGER

the MECHANICAL hand
that takes the chance
out of lamp-changing

You can't take chances on plant-safety. The NEW McGILL Lamp Changer RULES OUT bulb-changing chances. Constructed with rubber-covered fingers and a coil spring around the finger tips which grips and removes the bulb. McGILL Lamp Changer Poles have a 1 1/4" insulation-insert to prevent shock. Available in lightweight 5-foot lengths to a 30-foot maximum, McGILL Lamp Changers stop the threat in old-fashioned bulb-changing methods, halt risky ladder-climbing, box and chair-balancing, and the ever-present danger of shock and burn. Don't wait for a chance accident to help you decide. Order a McGILL LAMP CHANGER from your jobber.

McGILL
MANUFACTURING CO., INC.
Electrical Division
VALPARAISO, INDIANA

both the apparatus & supplies and appliance divisions, and will coordinate Wesco lamp activities with Westinghouse Lamp Division Headquarters at Bloomfield, N. J.

Succeeding Mr. Hjelte as headquarters sales representative at Chicago is W. C. Kincaid. He was formerly southern California sales representative.

William R. Jennings has been appointed lamp sales supervisor for the New England district.

With the opening of the new Boise, Idaho, branch house on 710 Front Street, James R. Adolphson was named branch stores manager. He was formerly a branch office manager at Salt Lake City.

R. C. GRAVES WITH FEDERAL ELECTRIC PRODUCTS CO.

The appointment of Robert C. Graves as vice president in charge of sales of Federal Electric Products Company, Newark, N. J., has been announced.

Mr. Graves brings to Federal more than 28 years of experience in the electrical manufacturing industry. He



R. C. GRAVES

was connected with the Trumbull Electric Manufacturing Company since his discharge from active duty as an ensign in the Navy at the close of World War I. In 1944, he became vice president of the firm, in charge of sales.

For the past 15 years, Mr. Graves has been closely identified with NEMA, during which time he participated in the work of various committees and sections.

R & I. E. MERGES WITH I-T-E

The I-T-E Circuit Breaker Co. has acquired the Railway & Industrial Engineering Co. as a subsidiary. This announcement was made in Philadelphia recently by W. M. Scott, Jr., president of I-T-E, and B. W. Kerr, president of R. & I.E.

The present intention is to have the I-T-E plant at Philadelphia and the R. & I.E. plant at Greensburg, Pa.,

New HEAVY-DUTY ELECTRIC PLANT

5000 WATTS

Only 272 lbs!

SCK-115M
\$545⁰⁰
FOB MINNEAPOLIS

- Large capacity, compact design, and lightweight aluminum construction are combined in this new, rugged, portable electric plant. Easily carried by two men. Powered by Onan 10 HP horizontally-opposed, two-cylinder, 4-cycle, air-cooled engine. Unusual operating economy. Shipped complete, equipped with four-receptacle outlet box and mounted in tubular-steel guard frame.

NEW ONAN CK ELECTRIC PLANTS are available in 5,000 Watts D.C., 115 and 230 volts; 2000 and 3000 Watts A.C. in all standard voltages.

ONAN ELECTRIC PLANTS—A.C.: 350 to 35,000 Watts in all standard voltages and frequencies. D.C.: 600 to 15,000 Watts, 115 and 230 Volts. Battery Chargers: 500 to 6,000 Watts, 6, 12, 32 and 115 Volts.

ONAN AIR-COOLED ENGINES—CK: 2-cylinder opposed, 10 HP. BH: 2-cylinder opposed, 5.5 HP. IB: 1-cylinder, 3.25 HP.

D. W. ONAN & SONS INC.
2133 Royalston Ave., Minneapolis 5, Minn

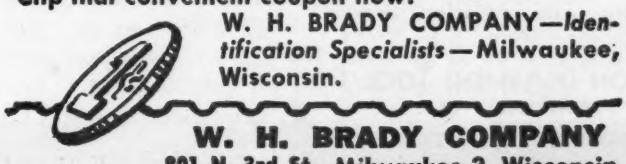
Write for Catalog

ONAN ELECTRIC PLANTS



THREE PENNIES IN POSTAGE will bring you the answer to real cost reductions in marking wires, leads, circuits, relays, parts, etc. • As alert production, maintenance and repair men everywhere have discovered, QUIK-LABELS do the job better, faster and cheaper than string tags, roll tapes, decals, stencils, metal tabs, etc. • You can't afford not to look at QUIK-LABELS . . . particularly when a 3c stamp will bring you FREE SAMPLES by return mail. Clip that convenient coupon now.

W. H. BRADY COMPANY—Identification Specialists—Milwaukee, Wisconsin.



W. H. BRADY COMPANY
801 N. 3rd St., Milwaukee 3, Wisconsin

Please send me FREE samples of QUIK-LABELS, the modern time and money saving way to mark wires, leads, circuits, relays, parts, etc.

Name _____

Position _____

Please attach to your BUSINESS letterhead

"The name is CHANNELLOCK"



Choose the plier that meets your needs from our complete line.

Only these pliers incorporate the exclusive Channellock tongue and groove joint. This patented joint is far superior to the conventional type of adjustable pliers for these reasons:

1. Greater Strength.
2. Longer Wearing.
3. Closely Spaced Adjustments.
4. Self Cleaning.
5. Visible Adjustments.
6. No wear on Joint bolt.

Send for free catalog illustrating our complete line of Champion DeArment Channellock tools.



Channellock Pliers are specifically designed for:

Battery Work Ignition Work
Pump Repair Electrical Repair
Plumbing Work
General Automotive, Electrical,
Plumbing and Aviation Service
work

CHAMPION DEARMET TOOL CO.
MEADVILLE • PA.

Only
Champion DeArment makes

CHAN NEL LOCK

continue to make their present products. R. & I.E. will continue to operate under its established name with its present management personnel "virtually unchanged". Mr. Scott will be president of both companies. B. W. Kerr, formerly president, and K. S. Nevin, vice president, treasurer and general manager of R. & I.E. become directors of I-T-E. In addition, Mr. Kerr will be chairman of the executive committee of I-T-E's board, as well as chairman of the board of R. & I. E.

FAIRBANKS-MORSE CHANGES

Fairbanks, Morse & Co., Chicago, announce the following changes in their sales organization.

J. C. Elmburg, manager of the Boston branch house, has been transferred to the Atlanta, Ga., branch house to assume the position of manager of that area. He replaces G. N Van Epps who recently resigned.

V. O. Harkness, who has been manager of the Diesel Division at Chicago headquarters, has been appointed manager of the Boston branch and T. M Robie of Chicago has been appointed to the position of manager of the general diesel sales division.

DAY-BRITE APPOINTMENTS

Joseph N. Crevasse has been appointed sales representative of Day-Brite Lighting Inc. He will cover the state of Florida with headquarters in Jacksonville.

Henry R. White has been named sales representative covering southern California. Mr. White will have headquarters at the H. R. White Co., 912 E. Third St., Los Angeles, Calif.

B. H. Johns, for the past seven years manager of the St. Louis branch of Independent Pneumatic Tool Company, has been appointed manager of the company's mining and contractors tool sales division, with headquarters at Chicago.

W. B. Smith, former manager of the Houston branch will succeed Mr. Johns as manager of the St. Louis branch, and R. F. Caslin, former Thor electric tool service engineer in the Houston territory, has been appointed to succeed Mr. Smith as Houston manager.

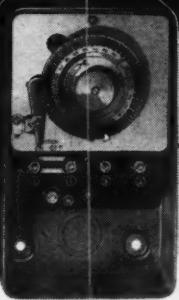
The Esterline-Angus Company, Inc. of Indianapolis, Ind. announces the appointment of W. H. Bollinger as representative for the Pittsburgh territory. This territory includes the western half of Pennsylvania and most of the state of West Virginia. He succeeds T. A. Kenny, who has been transferred to the New York Metropolitan area.



DEPENDABLE "Old timer"

Paragon

ESTABLISHED
1905



300 Series

From \$11.75 List

TIME CONTROL SWITCHES

For better construction and easier maintenance of your installations, depend on timers ... Paragon Engineered ... Underwriters Approved ... Telechron Motored. The 300 Series shown above are popular for Stokers, Oil Burners, Pumps, Valves, Window and Sign Lighting.

ASK YOUR JOBBER



700 Series. 7 day Dial Time Switches. Setting for each day in week. For Heating ... Ventilating ... Air Conditioning. From \$24.50 List.



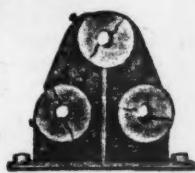
PS-30 Series. Poultry Time Switches for permanent installations. Provision for Bright and Dim circuits. \$13.50 List.

LIBERAL TRADE DISCOUNTS

PARAGON ELECTRIC COMPANY
1614 TWELFTH ST.
TWO RIVERS, WISCONSIN

SIMPLICITY PLUS!
New NON-INDUCTIVE
CABLE RACK

for
INDUSTRIAL
PLANT
WIRING



Type D-F 3-Conductor
Cable Rack, New Non-
Inductive Design. Racks
available for cable sizes
from 5/16 to 2 1/2"

Radically different, the new M. & W. Non-Inductive Cable Rack is designed for A.C. or D.C. systems. Racked Cables only partially surrounded by metal eliminates any chance of induced current in the rack. Impedance reduced with cables mounted in delta formation. Rack of one-piece construction . . . installation of cables made quick and easy through the use of split bushing.

Send today for Bulletin C-S-51
which illustrates the complete line

**THE M. & W. ELECTRIC
MANUFACTURING CO., INC.**
EAST PALESTINE, OHIO



All Sherman Lugs are individually inspected before shipment to maintain accurate dimensions and eliminate flaws affecting service qualities.

H. B. SHERMAN
Manufacturing Co.
Battle Creek, Mich.

Sherman
SOLDERING
LUGS

POWERS VOLTESTER

CATALOG NO. E 112

Is a practical tool for ordinary voltage testing. It is equipped with a six-watt Mazda lamp (not a neon lamp) which will tell you positively at a glance whether the circuit is HOT and HOW HOT.

You should know if you are working on 110-220-440 or 550 volts. A POWERS VOLTESTER tells you definitely. You need no light to read the voltage shown with this tester. It tells you by the brilliancy of its own light what voltage you are on.

If you must know the exact voltage reading use a Volt Meter. But for practical testing use a POWERS VOLTESTER.

Sold Only Through Distributors

LIST PRICE WITHOUT LEATHER CASE.....5.20

LIST PRICE WITH LEATHER CASE (Attachable to belt)....6.60

MADE
BY

POWERS MFG. CO.

1527 FOLSOM ST.
SAN FRANCISCO 3, CAL.



Licensed under
U. S. Pat.
No. 2341520
Others Pending

For Performance!

**MAGNO-TRONIC
DUAL SILVER POINT
ELECTRODYNAMIC
FLUORESCENT STARTER**

A precision built instrument of established merit incorporating the following features—starting reliability coupled up with a fully automatic circuit breaker that will cut out a deactivated tube from the circuit—no manual reset required to allow starter to perform all of the lamp starting functions when a good lamp is installed. Contacts are made of noble metal assuring longevity, durability and economy.

You'll find Industrial Electronics products in factories, office buildings, stores, railroad terminals, shipyards, schoolrooms . . . everywhere contributing to the comforts of American Life.

The (SP-15-20) for use with either 15 or 20 watt lamps
The (SP-30-40) for use with either 30 or 40 watt lamps

The (SP-100) for use with 100 watt lamps

Ask for descriptive literature

INDUSTRIAL ELECTRONICS CORP.

80 Bank Street



Newark, N. J.

famous splices

PLUM PUDDING and BRANDY ... True, lasting satisfaction . . . like splices with SUPER-STIK. Distributed only by authorized electrical wholesalers.

Super-stik
FRICTION TAPE
"Sticks to the End"

SUPERIOR INSULATING TAPE COMPANY
ST. LOUIS, MO., U. S. A.
Established 1923

"EFFICIENCY" DEVICES FOR CONDUIT AND CABLE SUSPENSION

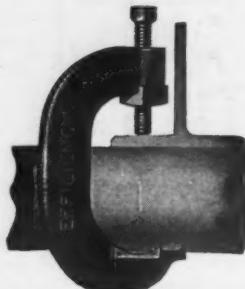
EFFICIENCY CONDUIT HANGERS FOR INDUSTRIAL CONSTRUCTION

The most practical and widely adaptable hanger ever devised for supporting conduit or armored cable on open steel construction. Will carry pipe at any angle to beam.

CAT. NO.

F379
F380
F381
F382

Highest grade malleable iron, guaranteed against breakage. Set screw, cup pointed, tightened by free nut, plus 5-point radiating ridges of gripping surface holds pipe on true mechanical principle, guaranteeing a solid, non-slip support.



WRITE TODAY for our Catalog No. 38 . . . contains complete information on this and other EFFICIENCY Electrical Devices

Efficiency
ELECTRICAL AND MANUFACTURING CO.

MANUFACTURERS OF
ELECTRICAL DEVICES FOR CONDUIT
WIRE AND CABLE SUSPENSION

Syntron Company of Homer City, Pa. has purchased the former H. K. Porter Company at Blairsville, Pa. Syntron plans to transfer the manufacture of its large, heavy duty vibratory feeders and equipment to Blairsville. The company's general offices and headquarters will remain at the Homer City plant.

A branch sales office has been established in Montreal at 4695 Sherbrooke Street, West, under the supervision of C. F. A. Gray.

Appointment of Clarence H. LeVee as manager of electric utility sales has been announced by the wire and cable department of United States Rubber Company. His headquarters will be in the company's general offices, 1230 Avenue of the Americas, New York, N. Y.

Neil C. Reed has been appointed eastern district manager of the Westinghouse Elevator Division. He succeeds Robert H. Wagner, who has become Pacific Coast district manager of the division, with headquarters in San Francisco.

Triangle Conduit & Cable Co., Inc. of New Brunswick, N. J. has announced the appointment of J. G. Slater, formerly treasurer, as vice president and treasurer and C. V. McKay, formerly assistant to the president, as vice president.

Mathias Klein & Sons, Chicago, has announced the appointment of Harry B. Wilson, Jr. as assistant sales manager.

C. M. Waite, who for the past 19 years has been with Wm. Wurdack Electric Mfg. Co., of St. Louis, is now with the Zinsco Electrical Products, Inc. of Los Angeles.

Ward Leonard Electric Co. has named W. R. L'Hommedieu, 722 East Washington Blvd., Los Angeles, California as sales representative in the Los Angeles areas.

The American Coach & Body Company, Cleveland, Ohio has named Leonard A. Stewart as chief engineer.

The Elastic Stop Nut Corporation of America of Union, N. J., has purchased the majority stock interest in the Buchanan Electrical Products Corporation.

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MULTI INDUSTRIAL LIGHTING EQUIPMENT

for Best Results
in Service and
Appearance . . .

Modernization demands the most efficient and best looking lighting installations. MULTI is the complete line for the contractor who wants to be sure that the fixtures he installs are the last word . . . no after worries—just first class service and a good looking job. Select the right unit from the right line—MULTI.

• Send for our
complete catalog

MULTI
ELECTRICAL MANUFACTURING CO.
4223 W. Lake St., Chicago 24, Ill.

**CUT DAYS OFF
WIRING JOBS...**



WITH THE KETT TALL REACH WOOD BORER

Bores Thru Wood, Steel, and
Masonry! Does Five Day Hand
Boring Job in Less Than A
Day

• The KETT Borer solves every boring problem for electrician, plumber, etc. Eliminates ladder-climbing . . . reaches up 10 feet above floor. Removed from extension, it's a versatile hand tool . . . boring in "hard" corners. Paying for itself on the first few jobs, the KETT Borer saves time, money, worker fatigue and accidents. Customary bits in 11/16", 12/16" and 16/16" sizes available. See your distributor for demonstration or write for Bulletin F.

THE KETT TOOL COMPANY

5 EAST THIRD STREET
CINCINNATI 2, OHIO

Bend Conduit Cold-

Here's How



Conduit can be bent



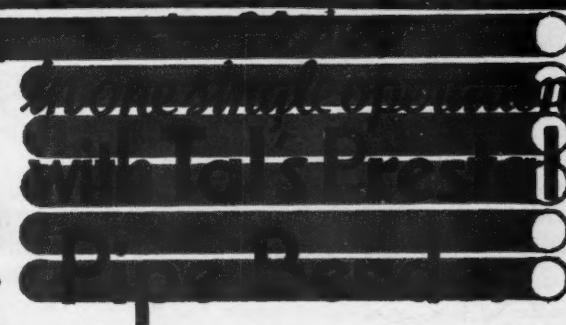
to any desired angle



without moving pipe



in one operation



Installation work goes faster, easier, and at a lower cost when you have a Tal's Prestal Bender on the job. This efficient, light, portable machine handles all pipe and conduit up to 3". Makes perfect bends, up to 90°, cold, in one single operation. No need to waste labor by replacing the pipe three to six times to make a bend. Does a good workmanlike job—smooth, uniform bends without kinks or wrinkles.

Simple and easy to operate. Thousands are in successful use everywhere. Write for data bulletin.

Tal Prestal Bender, Inc.

Dept. EC-12, Milwaukee 2, Wisconsin

FOR FASTER SOLDERING 2 NEW WELLER SOLDERING GUNS

with

Solderlite



You can speed up and simplify the tough soldering jobs in electrical repair and maintenance work when you use the Weller Soldering gun with Solderlite. Fast 5 second heating eliminates waiting time. Built-in spotlight finds the job faster, puts light right where you need it. Loop tip can get between wires; can be formed to get into corners. Dual heat Model D-207 has 100/135 watts—enough heat to handle electrical maintenance jobs such as soldered connections encountered in motor rewinding, electrical and electronic control repair, instrument and meter work, etc. See your electrical wholesaler or radio parts jobber.

WELLER
MANUFACTURING CO.
815 Packer St., Easton, Pa.
In Canada: Atlas Radio Corp., Ltd., 560 King St., N. W., Toronto, Ont.
Export Dept.: 25 Warren St., New York 7, N. Y.

IMPROVED LIGHTING INCREASES PRODUCTION

[FROM PAGE 64]

gineering services, totalled \$6,497.78. Based on 15-year amortization, this represents a yearly square-foot cost of \$.0969. Room painting, a normal maintenance item, is not included in this figure, but the figure does include re-finishing machines, furniture, etc., and installation of new floor, new lighting fixtures and rewiring.

PBA points out that additional maintenance is required in this room, due to a large number of lighting units and due to the lighter finishes of floor, furniture and equipment. After analysis of work rate by Public Health Service, which showed an increase of 5.5 percent in production, and analysis of all factors involved, both PBA and PHS officials conclude that the improved lighting, better environment and proper care of workers' eyesight results in more and better work by employees. Also, the employees indicated by replies to a questionnaire that they very much favored the environmental change. The report points out that the work rate would have increased considerably beyond 5.5 percent, except for the fact that income tax forms for 1946 were considerably more complicated than 1945 forms. Total cost of the project amounted to only 2.7 percent of the annual payroll for the department. Thus the 5.5 percent increase in production indicates project was paid for in six months.

While PBA and PHS were responsible for the program and report, they point out that several other Federal and private agencies participated in the work. These included the Bureau of Internal Revenue, National Bureau of Standards, National Society for Prevention of Blindness, Faber Birren and Company, Remington Rand Business Machine Division and Purdue Industrial Vision Institute.



Directing activities of the Regent Electric Company, Chicago contractors, are (L to R) Lawrence Pierce, manager and Wm. A. Traver, owner.

TORK CLOCKS

TURN ANYTHING
ELECTRIC
“ON” AND “OFF”
REGULARLY
AND AUTOMATICALLY.



TORK CLOCKS

For all types of electrical switching and time control; standard 24-hour models available for 110 or 220 volts, 60 c. A.C. Additional features such as Astronomic Dial, Weekly Calendar Wheel, additional "ON" and "OFF" operating arms, Selectors, Time Delay circuits, and other features are available to meet your requirements. Prices from \$13.00 list and up. We will be pleased to recommend the Tork Clock best suited to your needs.

SHOW WINDOWS
SIGNS AND POSTERS
HEATING CONTROL
AIR CONDITIONING
POULTRY HOUSE LIGHTS
DEFROSTING
FREEZER UNIT ALARMS
STREET LIGHTING
APPLIANCE CONTROL

ASTRONOMIC DIAL "ON" and "OFF" operating arms are adjusted daily to run time automatically. Follows changing seasons with uncanny accuracy, requiring no attention after being set when installed. Price—only \$12.00 extra with any Standard 24-hr. Model Tork Switch. Write for complete bulletin on Astronomic Dials and other Tork Products.

TORK CLOCKS



'SAFETY SET'
COMMERCIAL
WALL CLOCK

No standing on chairs; electrosetting mechanism allows clock to be re-set easily from the floor. Reflectionless 14" dial; spun aluminum case, white, maroon and polished aluminum. Self-starting, 110 volts, 60 cycle A.C.

TORK CLOCK CO.
MOUNT VERNON NEW YORK

ILSCO

LUGS AND
CONNECTORS

**ADDED STRENGTH
WITHOUT ADDED COST or WEIGHT**

SERRATIONS in collar and tang provide added strength against pull-out.



MORE THREADS are gained through the deep boss.

COLLAR SECTION cannot pull out because prefabricated from drawn seamless copper tubing.



TODAY

write for 48-page illustrated catalog and data on connectors, soldering and solderless lugs, fuse clips, etc.

ILSCO

COPPER TUBE
& PRODUCTS, Inc.
CINCINNATI OHIO

ROTARY DRILL MASONRY 4 TIMES FASTER

Carboly® Masonry

Drills Fit Any
Rotary Drill,
Hand Brace,
Drill Press

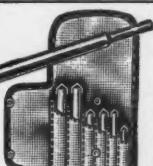


- Stay Sharp up to 50 Times Longer
- Cut Clean-Edged Holes Close Together Without Break-Through
- Drills Concrete, Brick, Plaster, Slate

Tips of the hardest metal made by man, set in solid round shanks, make Carboly Masonry Drills superior tools for drilling holes for expansion anchors, etc. Faster drilling, 50 times longer life means vast savings in time and money.

15 POPULAR SIZES IN ALL

Handy 6-drill set— $\frac{3}{16}$ ", $\frac{1}{4}$ ", $\frac{5}{16}$ ", $\frac{3}{8}$ ", $\frac{1}{2}$ " and $\frac{5}{8}$ ", only \$13.70—in free canvas kit. From your dealer, or direct from: Carboly Company, Inc., 11175 E. 8 Mile Ave., Detroit 32, Mich.



***CARBOLOY**
TRADEMARK
CEMENTED CARBIDE
MASONRY DRILLS

IN LOOKING FORWARD TO A BRIGHTER WORLD OF TOMORROW

WE WISH TO ALL OF OUR
GOOD FRIENDS AND CUSTOMERS

*a Very Merry Christmas
and a Happy
& Prosperous New Year*

ALL-BRIGHT ELECTRIC PRODUCTS CO.

3917-25 N. Kedzie Ave.

Chicago 18, Ill.

ELECTRICITY

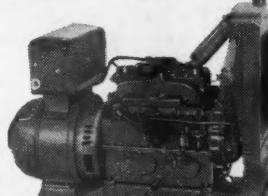
WHERE YOU NEED IT . . . WHEN YOU NEED IT
with a

Universal
"MATCHED UNIT"

ELECTRIC PLANT



Universal 2,000-watt Models — for lighting, powering tools, radio, etc. One-cylinder, air-cooled engine.



Universal 6,000-watt Series — for medium power requirements. Four-cylinder water-cooled engine. Other models, one to six cylinders, 250 to 25,000 KW.

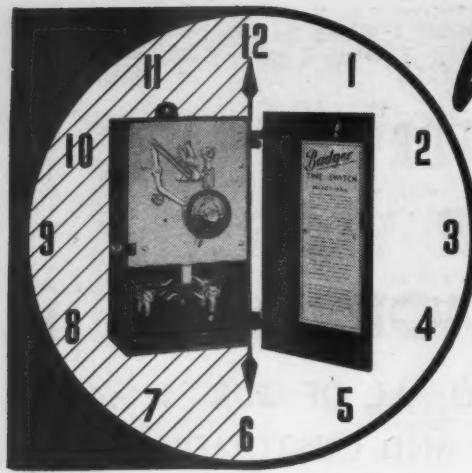
SEND FOR FOLDER, "ELECTRICITY AT LOW COST!" Gives Full Story of Universal Design—Shows 16 Different Models.

Contractors and Representatives. Write for details on the profitable Universal franchise.

UNIVERSAL MOTOR COMPANY

FOUNDED 1898

438 UNIVERSAL DRIVE • OSHKOSH, WISCONSIN



Which Time Switch?

- 30 or 50 Amps.
- Standard or 2-Circuit
- Plain or Astronomic
- Indoor or Outdoor Cases

● Reliance Time Switches—our customers tell us—are well-named. Many say our standard electric time switches meet practically all of their automatic control requirements. Some users have enjoyed dependable Reliance service for more than 35 years. You, too, can rely on the Reliance line. Ask your distributor or write—Reliance Automatic Lighting Co., 1937 Mead St., Racine, Wisconsin.



RELIANCE TIME SWITCHES

7½ HOURS SAVED

BECAUSE THE CUTTING EDGE
is KENNAMETAL



TRADE MARK
REG. U.S.
PAT. OFF.

Saving 7½ manhours in one day is typical performance for Kennadrills—the new rotary drills having cutting tips of Kennametal cemented carbide—the metal that is far harder and more durable than the hardest tool steel. No starting punch needed—Kennametal tip takes hold readily, drills fast, retains sharp edge under heat and abrasion.

Can be used in any standard rotary electric drill on all types of masonry. Available in following drilling diameters: $\frac{1}{8}$ ", $\frac{3}{16}$ ", $\frac{1}{4}$ ", $\frac{5}{16}$ ", $\frac{3}{8}$ ", $\frac{7}{16}$ ", $\frac{1}{2}$ ", $\frac{9}{16}$ ", $\frac{5}{8}$ ", $\frac{11}{16}$ ", $1\frac{1}{8}$ ", $1\frac{1}{4}$ ", and $1\frac{1}{2}$ ".

Distributors Wanted

KENNAMETAL Inc., LATROBE, PA.

KENNADRILLS

DRILL MASONRY FASTER, CHEAPER, EASIER

MOTOR STRIPPING

[FROM PAGE 61]

performed in special roasting ovens, and that the best method of stripping is by roasting.

The reactions of the men operating the special ovens are all favorable and the men are unanimous in praising the new method.

A special controlled temperature roasting oven, capable of handling both stator and transformer windings in large repair plants, costs approximately \$4500. It can be used for both small and large equipment.

A small oven suitable for roasting only motor stator windings up to and including the 5 hp. size, costs approximately \$1500. It is not necessary or economical to install one of these with a large oven except where required because of plant layout or special service requirements.

Based only on reduction in roasting time, transformer repair cost is reduced approximately 1.7 percent and a-c motor and generator repair cost is reduced approximately 2.86 percent.

Based on the above reductions, the experiments show that the investment for the large oven can easily be amortized in a year when the yearly volume of business involving transformer and a-c stator repair is near \$170,000. The amount required to amortize the small oven is approximately \$57,000, motor business only, an amount proportionally smaller than for the large oven.



James D. Lynett, chairman of the 1947 annual meeting Committee, Eastern Section, IAEI, talks over Section activities with C. A. Berlepsch, member of the Executive Committee and chairman of the Displays Committee during meeting at Atlantic City, N. J.



Repeat Sale Regulars

Candylbeme Lamps

The beauty of crystal and polished fixtures is emphasized by Candylbeme Lamps. Radiating without diffusion they give sharp brilliant reflection. Effectively increase sales of fixtures and lamps alike.

Candleflame Lamps

Especially effective in candelabra and side-wall brackets. Give a soft, diffused glow. In clear, frosted, or a variety of tints. Install in fixtures for faster turnover.



Carbon Pilot Lamps

Extra long life, and designed to withstand vibration and shock. Available in standard or special shapes, sizes, colors or base.

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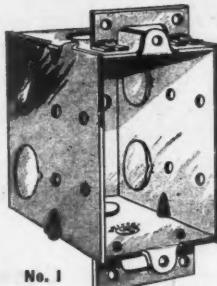


The New MODEL B-7 **MEGOHMER**

with any other insulation tester. See the difference. More scale divisions, longer aggregate scale, easier to use, no cranking, saves time and effort, reads as low as 1/10 of one Ohm to 200 Megohms. Two test potentials 250/500 volts. 0-20/200 Megohms, 0-200/20,000 Ohms. Bulletin No. 440 EC.

HERMAN H. STICHT CO., INC.
27 PARK PLACE NEW YORK 7, N.Y.

Electric Switch and Outlet Boxes Available for Immediate Shipment



No. 1
2 3/4" deep, 1/2" knockouts, ears attached.



No. 2
2 1/4" deep, romex clamps, ears attached.

Aluminum electric switch and outlet boxes . . . approved by Underwriters Laboratories, Inc., Chicago, and REA.

Immediate Delivery of any quantity desired. All boxes guaranteed against defective workmanship or material. Check these features:

- Precision made. Die stamped, press formed from .091 gauge sheet aluminum. Conform to all building codes and requirements.
- Longer lasting—rust & acid resistant.
- Light weight—easy to handle, inexpensive to ship.
- Sturdy construction—will not bend or break.
- Easy knockouts.

See your jobber today. If he cannot supply you write direct.

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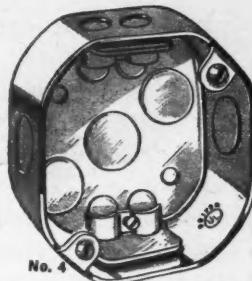
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WEST COAST AGENCIES
129 1st Ave. W., Seattle 99, Wash.



No. 3
2" deep, 1/2" knockouts, ears attached.



No. 4
4" Octagon, 1 1/2" deep, three 1/2" knockouts and 4 loom knockouts in bottom with clamps. Two 1/2" knockouts and 4 loom knockouts in sides. One piece draw. Also available with all 1/2" knockouts.

Jenkins Bros. also make Diamond Seal Friction and Rubber Tape which meet ASTM and Federal Specifications.



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- Like skilled chefs, tape experts in the Jenkins laboratory check every step in the manufacture of Gold Seal. That's why Gold Seal always has plenty of tack . . . never ravels, peels, smears your hands, or dries out. Ask for Gold Seal, by the box or the handy ten-roll can. Every roll is cellophane wrapped. Jenkins Bros. (Rubber Division) 80 White Street, New York 13, N. Y.

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PIPE BENDER



Blackhawk Benders do MORE than bend pipe. They include a Porto-Power Hydraulic Unit that performs this triple job:

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Bends rigid conduit and pipe of all popular diameters. Saves need for elbows, couplings and extra cutting and threading.

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Porto-Power pushes, pulls, bends, presses, spreads, and clamps—pulls gears, lifts machinery and licks scores of other jobs.

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BLACKHAWK
WORLD'S LARGEST MANUFACTURER OF HYDRAULIC JACKS

SIGNAL INSTALLATION METHODS
[FROM PAGE 59]

boxes before the finishing plates or covers are fastened. Should the wires be caught in between, grounds may occur by parts of the instrument housing or screws cutting into the wire or insulation. Outlet boxes for equipment must be sufficiently large to house the apparatus, wires, splices and joints, locknuts and bushings, without forcing the plates and covers for a proper fit. Barriers must be provided in outlet boxes to separate the low voltage systems from the outlets being served directly from the lighting circuits.

Terminal blocks should be used at all junction points such as junction boxes and cabinets. Standard size blocks should be selected, choosing the one which when multiplied will result in ample terminals for all wires, plus some spares for expansion.

In intercommunicating telephone systems the voltage of the telephone battery or other current supply should not be increased beyond that recommended by the manufacturer. Considerable damage will be done to the instruments and particularly to the transmitters.

Battery wires should not be connected permanently before ascertaining that the system is clear of short circuits or grounds. Failure to clear such troubles may run down the battery within a very short time, possibly over night. On the other hand if a rectifier is used, irreparable damage may be done to same under similar conditions.

In making connections from underfloor ducts to equipment on desks, counters etc., it has been found practical to use separable connectors. These permit ease in connection and in isolating trouble when maintaining the systems.

In surface installations individual and twisted conductors may be fastened with insulated staples or insulated nails with large heads. Cables are preferably fastened with straps. Such wires and cables should be properly protected where they pass through walls and floors in order to prevent damage.

Most signal systems installed by electrical contractors come under the classifications 2, 3, and 4 of the National Electrical Code or similar local Municipal ordinances. These rules should be followed in installing wires, size of conduits, fusing circuits and sources of power for the operation of the various systems.

QUICK POSITIVE READINGS
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PHASE ROTATION INDICATOR

50 to 600 volt, 25 to 120 cycles, 2, 3, or 6 phase

- The SELCO Indicator gives you quick positive readings. Avoids costly mistakes.
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AEMCO Automatic
TIME SWITCHES
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Stock Models from
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CHECK THE Automatic LINE

For any load . . . for every installation, there is an Automatic Time Switch to meet the most rigid specification. Compact, ruggedly constructed Automatic Switches have pure silver contacts . . . tamper proof cabinets with visible dial . . . 2 to 24 "on" and "off" operations. For dependable automatic time switches specify *Automatic*.

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have complete information on Automatic products. Catalog mailed direct at your request.

WRITE TODAY!

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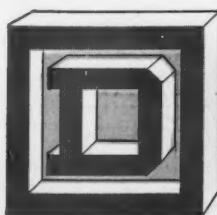
When Your Customers Ask . . . "What about Multi-Breakers?"

These few simple facts tell the whole story:

- 1 A Multi-breaker is the modern circuit wiring protector or "safety valve" for electrical circuits.
- 2 It automatically disconnects the circuit should a short circuit or dangerous overload occur.
- 3 Multi-breakers operate without fuses and there is nothing to replace to restore the circuit.
- 4 A simple movement of the lever restores current after the cause of the short circuit or overload has been removed. There are no delays—no fuss or bother.
- 5 Multi-breakers meet the 1947 National Electrical Code. They are non-tamperable.
- 6 On the average, Multi-breakers cost no more—sometimes less.

Quote both ways—with Multi-breakers and with fusible equipment. In the vast majority of cases, you'll find the choice is Multi-breakers.

The **MULTI-BREAKER** eliminates fuses completely. It is neat and compact—can be installed in any convenient wall. It provides the protection and convenience which every modern home deserves.



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*This Name
shows him what
convenience
means*

This man is looking at a convenience outlet. He once thought that only a customer would find it "convenient." But now that he has changed to General Electric, he has discovered that easy handling and easy installation give extra meaning to that term. He has learned that this outlet, GE 2679 — and a wide variety of other General Electric wiring devices — have been designed to help make his job less difficult. Plaster ears are included to make mounting simpler. T-slots provide extra leeway in positioning. Durable brown or ivory color body improves appearance, and assures long service. Even more important, a wide range of sizes, types, and capacities allows him to select the proper outlet for any job from a single source of supply.

But the real convenience comes when this man (and thousands like him) mentions the name behind the product — General Electric. It gives *customers* extra faith in his good judgment. It helps *him* to be sure that the wiring he installs will give long-term service. And it makes it easy to order with confidence any item in the full line of wiring devices. Just say G.E., and he'll agree.

WIRING DEVICES by
GENERAL ELECTRIC
say "G.E." and he'll agree

Wiring Briefs from your G-E Distributors

Are you familiar with the great variety of products in General Electric's full line of wiring devices? Do you know the interesting features that help to make them easy to use and easy to sell? Keep an eye on this column, and you may discover a lot of useful facts and information. We'll keep dishing them out for you.

Here's the switch for nurseries, theaters, and other places where silence is important. So quiet that you can't hear it operate, this silent General Electric mercury switch has no moving parts to wear out. It's a top-quality product that goes a long way in pleasing your customers.



How often have you had customers complain because of faulty power cords on lamps and appliances? General Electric's durable Flamenol* cord sets put a stop to these complaints, because they practically never wear out. Strong, age-defying, easily cleaned Flamenol cords are equipped with molded-on plastic plugs that are virtually indestructible.



Preassembled at the factory, Flamenol cord sets are supplied with conductors stripped for speedy installation. Use them on all light appliances, to add the extra evidence of quality that is the hallmark of General Electric — and your best bet for satisfied customers.

Rural America is "going electric" fast. And now is a good time to remind you that General Electric makes a complete line of surface wiring devices

to help you get a share of the profitable farm wiring business. G-E surface wiring devices are strong, light, easy to install, and popular everywhere for farm buildings, camps, garages, warehouses, or temporary wiring. Let us give you a descriptive folder.



If you want additional information on these, or other G-E Wiring Devices, ask us — your G.E. Merchandise Distributor — or write to Section D60-1218, Appliance and Merchandise Department, General Electric Company, Bridgeport 2, Connecticut.

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